CSM Unit 2, Midgradient Watersheds

Main Stem Coeur d'Alene River

CONTENTS

CONTENTS (Continued)

ATTACHMENTS

FIGURES

FIGURES (Continued)

TABLES

ABBREVIATIONS AND ACRONYMS

AWQC	ambient water quality criteria
BHSS	Bunker Hill Superfund Site
BLM	Bureau of Land Management
CDR	Coeur d'Alene River
cfs	cubic foot per second
CIA	Central Impoundment Area
COPC	chemical of potential concern
CSM	conceptual site model
CV	coefficient of variation
EPA	U.S. Environmental Protection Agency
EV	expected value
FIA	Federal Insurance Administration
FIS	Federal Insurance Study
FIS	flood insurance study
FS	feasibility study
ft	foot
I-90	Interstate 90
IDEQ	Idaho Division of Environmental Quality
in.	inch
Main Stem	Main Stem Coeur d'Alene River
MFG	McCulley, Frick & Gilman, Inc.
MidGradSeg04	midgradient segment 04
µg/L	microgram per liter
NOAA	National Oceanic and Atmospheric Administration
North Fork	North Fork Coeur d'Alene River
PDF	probability density function
PDF	probability distribution function
PRG	preliminary remediation goal
Qal	Quaternary alluvium
Qtog	Channel and Terrace Gravels
RAC	Remedial Action Contract
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
ROW	right of way
SFCDAR	South Fork Coeur d'Alene River

ABBREVIATIONS AND ACRONYMS (Continued)

SL	screening level
South Fork	South Fork Coeur d'Alene River
TMDL	total maximum daily load
UPRR	Union Pacific Railroad
URS	URS Consultants, Inc.
URSG	URS Greiner, Inc.
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WRCC	Western Regional Climate Center

1.0 INTRODUCTION

The Main Stem Coeur d'Alene River (Main Stem) Watershed contains the Coeur d'Alene River from the confluence of the North Fork Coeur d'Alene River (North Fork) and South Fork Coeur d'Alene River (South Fork) to where the old highway bridge crosses the river upstream from I-90 at Cataldo. The Bureau of Land Management (BLM) has identified five source areas (e.g., mining waste rock dumps, adits, and tailings piles) within the watershed (BLM 1999). The watershed has been heavily affected by mining activities and past and continuing releases of metals from mining wastes upstream in the South Fork.

Several clean-up actions have been implemented in the Coeur d'Alene River watershed between the confluence and Cataldo. These actions are primarily to protect human health and are response actions as implemented by the USEPA and the Union Pacific Railroad (UPRR). As a part of the Consent Decree for the UPRR Wallace-Mullan Branch, contaminated soils and ballast materials within the UPRR right of way (ROW) along the South Fork between the confluence and Cataldo are to be covered with an asphalt, gravel, or soil barrier, depending upon location. This action also includes limited removal of contaminated materials within selected railroad sidings near Enaville and Cataldo. One home adjacent to the UPRR ROW will be sampled; depending upon sample results, any residual contamination will be addressed. Fencing, large boulders, and hostile vegetation are used to prevent access to contaminated areas along the River at portions of the ROW near Enaville and the old CCC Road west of Enaville (MFG 1999). Implementation of this portion of the UPRR Response Action is also planned for the year 2000/2001 (MFG 2000).

This watershed is one of the three watersheds assigned to conceptual site model (CSM) Unit 2, Mid-Gradient Streams (see Part 1, Section 2, Conceptual Site Model Summary). The watershed itself is entirely within one segment (MidGradSeg04) (Figure 1.1-1). A brief description of the main steam Coeur d'Alene River Watershed is presented below.

1.1 WATERSHED DESCRIPTION

The Main Stem Watershed is a relatively flat, transitional alluvial valley which begins at the confluence of the North Fork and the South Fork Coeur d'Alene Rivers. The western extent of the Main Stem Watershed discharges to the Lower Coeur d'Alene River (Lateral Lakes Watershed, CSM Unit No. 3). The length of the Main Stem Watershed is approximately 6 miles from the confluence of the North and South Forks to the Interstate 90 crossing south of Cataldo (see Part 1, Figure 1.1-1). The main stem is transitional in that it is somewhat wider and flatter (with broader meanders) than the upper reaches of the Coeur d'Alene River (CDR), yet not as wide or flat as the Lower Coeur d'Alene River Watershed and Lateral Lakes region. Surface water and sediment derived in the North and South Forks are transported through the segment to the Lateral Lakes region. Surface water samples collected from this segment exceed ambient water quality criteria (AWQC). Concentrations of metals in sediment samples collected from this segment exceed screening levels for all ten metals of potential concern.

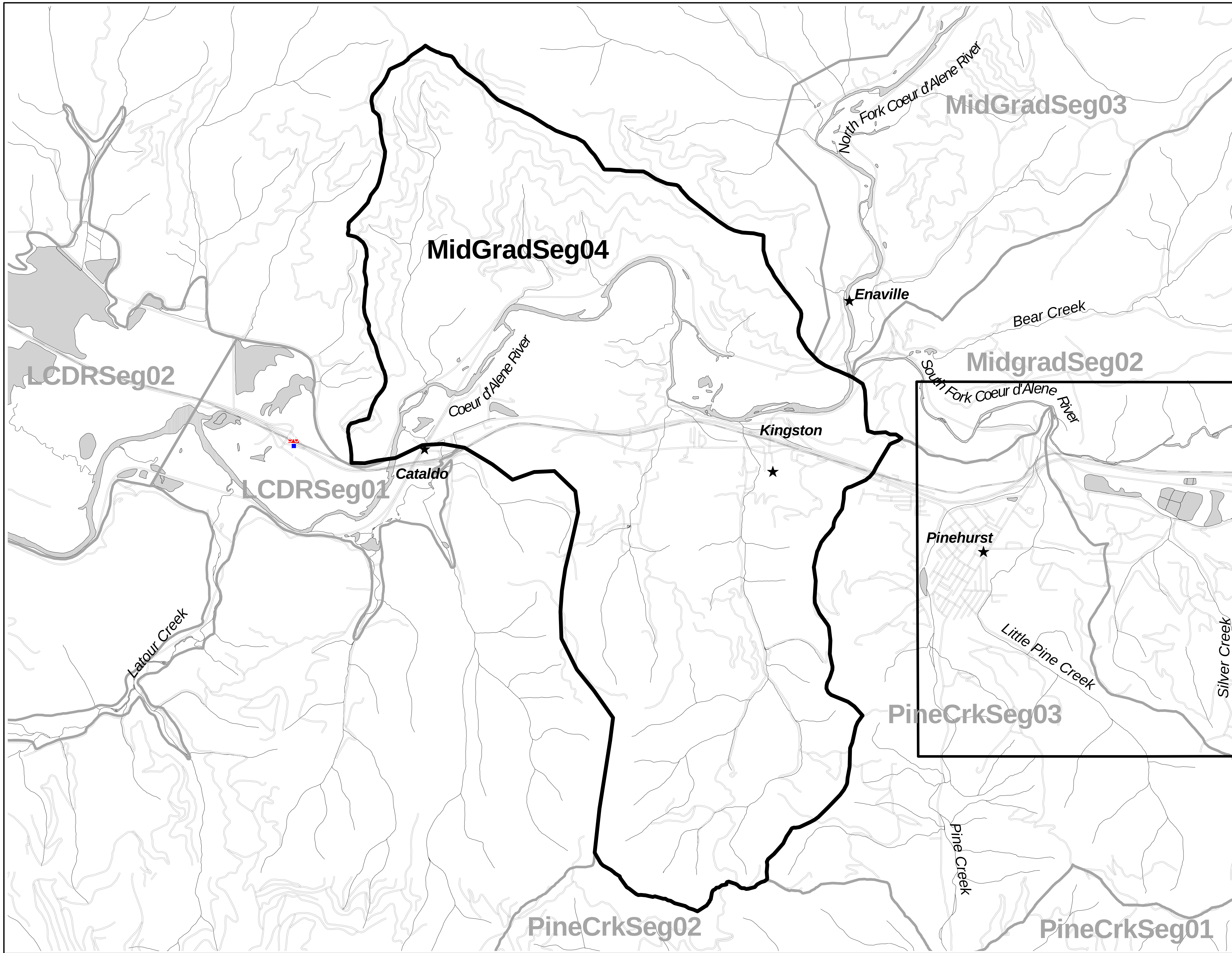
1.2 REPORT ORGANIZATION

The remedial investigation report is divided into seven parts. This report on the Main Stem Coeur d'Alene River Watershed is one of three reports contained within Part 3 presenting the remedial investigation (RI) results for the three CSM Unit 2 watersheds. The content and organization of this report are based on EPA's Guidance Document for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final (USEPA 1988). This report contains the following sections:

- Section 2–Physical Setting, includes discussions on the watershed's geology, hydrogeology, and surface water hydrology.
- Section 3–Sediment Transport Processes
- Section 4–Nature and Extent of Contamination, includes a summary of chemical results and estimates of mass loading from source areas
- Section 5–Fate and Transport, includes chemical and physical transport processes for metals
- Section 6–References

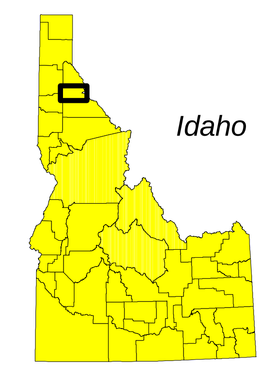
Risk evaluations and potential remedial actions associated with source and depositional areas are described in the human health risk assessment, the ecological risk assessment, and the feasibility study (all under separate cover).

Figure 1.1-1
Coeur d'Alene River Watershed



LEGEND

- Stream
- Road
- Interstate-90
- City
- Coeur d'Alene River Watershed
- River Segment
- Lake/River
- Bunker Hill Box



Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL, and the Bureau of Land Management.

SCALE 1:48,000

0.5 0 0.5 Miles

027-RI-C0-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

EPA REGION 10

Document Control 4162500.6615.05.a
Generation 1
n:\Projects\watersheds\14_h2oshed_6-9-00.apr
V:CDAR
E:CDAR
L:Final RI CDAR
7/16/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: JULY 16, 2001

2.0 PHYSICAL SETTING

2.1 GEOLOGY AND MINES

The geology and mining history of the main stem Coeur d'Alene River Watershed is discussed in this section.

2.1.1 Bedrock Geology

Weakly metamorphosed sedimentary rocks assigned to the Precambrian Belt Supergroup (Belt) are the most prevalent rocks in the Main Stem Coeur d'Alene River (Main Stem) Watershed. The most abundant Belt formation is the Precambrian Prichard Formation (Part 1, Figure 3.2-1) consisting of gray interlaminated siltite and argillite with minor quartzite (Bond 1978).

2.1.2 Structural Geology

The Main Stem Watershed (Part 1, Figure 1.2-2) exhibits two dominant structural trends: north-northwest-trending faults and roughly east-west-trending faults (Bond 1978). The faults are both normal and reverse faults, with dip-slip movement involving hundreds of feet of displacement and strike-slip movement of up to 16 miles (as seen on the east-west trending Osburn fault).

2.1.3 Soils

Like most of the soils throughout the Coeur d'Alene district, the soils in the Main Stem Watershed can be grouped into two broad categories: hillside soils and valley soils. Hillside soils are typically a silty loam with variable amounts of gravels and clay; they are generally less than 2 feet thick. Valley soils are found within the Main Stem drainage and on the adjacent floodplains (Part 1, Figure 3.2-1).

Valley soils in the Main Stem drainage are of two types: (1) Quaternary alluvium (Qal) which is unconsolidated sand, gravel, and clay valley fill material, and (2) older Channel and Terrace Gravels (Qtog) located topographically above the Qal along the hillsides and tributary valleys flanking the Main Stem.

2.1.4 Tailings

Tailings and related metal-enriched spoil materials (collectively referred to as tailings) produced by mining activities are present in varying thicknesses throughout the South Fork Watershed. The jig and flotation tailings in the Main Stem Watershed are mixed with lesser or greater amounts of naturally occurring alluvium. These deposits have been reworked and redistributed by periodic flooding and construction activities. The presence of tailings is indicated by elevated lead, cadmium, and zinc concentrations in soil samples collected in the Main Stem Watershed (Maest et al. 1999). The chemical and mineralogy content of the tailings mixture is discussed further in Section 4, Nature and Extent of Contamination.

2.1.5 Ore Deposits

This watershed is mostly outside the mineralized trends in the Coeur d'Alene District. One developed mine, the Hypotheek Mine, is located in the Main Stem Watershed.

2.1.6 Mining History

A brief summary of available information on historical mining activities is presented in this section. During the RI/FS process, an extensive list of mines, mills, and other source areas was developed based on a list originally developed by the Bureau of Land Management (BLM 1999). This list is presented in Section 4.1, Nature and Extent, and in Appendix I.

Between 1913 and 1954, at least one mine and mill (Hypotheek Mine and Mill) operated in the main stem Coeur d'Alene River Watershed. The Hypotheek Mine is located at the headwaters of French Gulch south of Kingston. Additional facilities associated with the mines are located to the east of Pine Creek. The Hypotheek Mine produced an estimated 88,702 tons of ore. From this ore, an estimated 8 million pounds of lead, 7,000 pounds of zinc, 62,000 pounds of copper, 50,000 ounces of silver, 600 ounces of gold, and 80,759 tons of tailings were produced (Mitchell and Bennett 1983; SAIC 1993). This mine was considered isolated from more mineralized areas, but when important ore discoveries were made, additional mining interests reportedly started operations in the area. No further information was available.

2.1.6.1 Mines

The mines that operated in the Main Stem Coeur d'Alene River Watershed, and for which production records were found, are listed in Table 2.1.6-1. This table includes the production years of the mine, the estimated volumes of ore and tailings produced as a result of the mining activity, and the identifier of the segment in which the mine is located. (See the Conceptual Site Model (CSM) for the descriptions of these identifiers.) Only mines with documented ore production are listed.

2.1.6.2 Mills

The Hypotheek Mine, located on a tributary to French Gulch, might have included a mill. However, no mill records were located. No other mill sites are known to have been located within this watershed.

2.1.7 Mine Workings

Underground workings in many mines are very extensive and act as collection and distribution systems for groundwater. Many adits and tunnels in the watershed act as discharge points for groundwater. Typically adit drainage discharges directly to surface water or first infiltrates waste rock piles before discharging to surface water from seeps.

The Hypotheek Mine in MidgradSeg04 is a potential collection/discharge point in the Main Stem Watershed. No information on adit discharge is available for this mine. Soil, sediment, groundwater, and surface water samples were not collected from this source area; therefore, potential contributions of metals from this area to the Main Stem has not been quantified.

2.2 HYDROGEOLOGY

2.2.1 Conceptual Hydrogeologic Model

The Main Stem Coeur d'Alene River (Main Stem) Watershed (Mid GradSeg04) is a relatively flat, aggraded, transitional alluvial valley which begins at the confluence of the North Fork and the South Fork Coeur d'Alene Rivers. The western extent of the Main Stem Watershed discharges to the Lower Coeur d'Alene River (Lateral Lakes Watershed, CSM Unit No. 3). The length of the Main Stem Watershed is approximately 6 miles from the confluence of the North and South Forks to the Interstate 90 crossing south of Cataldo (see Part 1, Figure 1.1-1). The Main Stem is transitional, in that it is somewhat wider and flatter (with broader meanders) than the upper reaches of Coeur d'Alene River (CDR), yet not as wide or flat as the Lower Coeur d'Alene River Watershed and Lateral Lakes region.

The current base level of the Main Stem Watershed is Coeur d'Alene Lake near Harrison (approximate elevation 2,120 feet) approximately 23 miles west of Cataldo. However, variations in base level over geologic time and attendant changes in prevailing geomorphological processes (downcutting of bedrock, glaciofluvial deposition and erosion, glacio-lacustrine deposition and aggraded channel deposition/reworking) have created the present day aquifer system that consists of unconsolidated sediments overlying the relatively less permeable rocks of the Belt Supergroup (Belt) in a narrow, elongate, trough.

In general, the Belt rocks have very low primary permeability. However, faulting and fracturing by tectonic processes, as well as human actions (e.g. mine workings [Section 2.1.7]) have created an enhanced permeability in some areas of the Belt. The sediments overlying the Belt rocks comprise the primary hydrostratigraphic units in the Main Stem Watershed.

Very little hydrogeologic data are available for the Main Stem. Norbeck (1974), provides a general description of the hydrostratigraphy of a study area, that includes the Main Stem, from Wallace to Rose Lake based on well logs, exposures of alluvium in the valley, and geophysical surveys. Norbeck (1974) reports the following information with regard to the valley-fill materials:

- Sediments become better sorted and finer grained in the west end of the valley, "with a large increase in the silt-size and smaller fractions".

- West of Cataldo, "they consist predominately of very fine sand, silt, and clay".

- A "thin soil" is developed on top of alluvium. The soil is distinguished by the presence of organic (humic) matter; and is mixed with or has been covered by tailings.

- Depth to bedrock ranges from 156 feet near Pinehurst to 196 feet near Cataldo to 414 feet near Rose Lake.

The composition, distribution, and hydraulic properties of the hydrostratigraphic zones in the Main Stem aquifer system are largely unknown. However, two well logs were reviewed from T49N/R1E sections 34 and 36 ("Hussa" well in section 34, "Hegman" well in section 36) that suggest a three-layered system (i.e. lower aquifer, aquitard, upper aquifer), analogous to the South Fork aquifer system, also exists in the Main Stem (Norbeck 1974). The South Fork aquifer system (MidgradSeg02 shown in Part 1, Figure 1.1-1), consists of one leaky aquitard separating a lower, confined water-bearing zone of Pleistocene glaciofluvial/alluvial sediments (lower aquifer) from an upper, generally unconfined water-bearing zone of contemporaneous alluvial sediments admixed with mill tailings (upper aquifer).

2.2.1.1 Groundwater Level Fluctuations

Groundwater levels in wells completed in the upper and lower aquifers beneath Bunker Hill fluctuate seasonally and are generally highest in the spring (April) and lowest in October through January (MFG 1992). This seasonal trend likely also occurs down-valley from the Bunker Hill area in the Main Stem Watershed although no data are available to support this assumption.

2.2.2 Aquifer Parameters

Aquifer parameters for the Main Stem aquifers are not available. However, based on the apparent lithological similarities (from well logs) with the upper and lower aquifers of the Smelterville Flats-Bunker Hill area, it is reasonable to expect that aquifer parameters for the Main Stem aquifers are similar to those in the western portion of the South Fork Watershed. The reported horizontal hydraulic conductivity in the South Fork Watershed range from 500 to 10,790 ft/day in the upper aquifer and 100 to 1,910 ft/day in the lower aquifer (MFG 1992). Due to a high degree of variability, and therefore uncertainty in aquifer parameters, site-specific data will need to be gathered for design.

2.2.3 Flow Rates and Directions

Although no data are available for groundwater flow rates and directions, groundwater flow direction in the valley-fill deposits in the Main Stem Watershed is expected to be down-valley (from east to west in the upper portion of the watershed, and from north to south in the lower portion) with minor variations near the mouths of tributary watersheds. No estimates of flow rates or velocities are available for the Main Stem Watershed aquifers.

There is expected to be a vertical hydraulic gradient across the aquitard (where present) as in the South Fork Watershed. Also, there may be movement of water across the aquitard (where present) as in the South Fork Watershed by one or more of the following mechanisms:

- Flow through the aquitard itself.

- Flow through perforations where the aquitard is absent (Williams 1989 - e.g. buried colluvium and weathered bedrock along the valley margins [MFG 1992]).

- Flow through wells connecting the upper and lower zones.

2.2.4 Surface Water/Groundwater Interaction

Previous studies (MFG 1992; Williams 1989) have reported that the South Fork is composed of both gaining reaches (where groundwater flows into the river) and losing reaches (where surface water flows into the upper aquifer or the single unconfined aquifer east of Kellogg). Specifically, where the valley-fill is narrow and/or thin (i.e. constricted valley) net gain to the river from the aquifer is observed; and where the valley fill is wide and/or thick (e.g. flats) net loss from the river to the aquifer is observed. Similar conditions are expected in the Main Stem Watershed although no data are available to support this assumption.

It is also reasonable to expect that areal limits and net flow rates of gaining and losing reaches on the Main Stem will vary from season to season and year to year, as a result of variations in recharge-discharge conditions. The hydrologic and wetland systems in the vicinity of the Cataldo Flats were investigated by Chamberlain and Williams (1998) to assess the role of natural wetlands in metals removal. The Cataldo Flats are covered by tailings and sediments that were deposited by or dredged from the Lower Coeur d'Alene River. Groundwater and surface water hydraulics as well as water quality were monitored. They reported that the floodplain and riverbank groundwater is recharged primarily by precipitation infiltration which is continuously dissolving large concentrations of cadmium, lead, and zinc out of the dredge spoils and into the river.

2.2.5 Groundwater Use

Norbeck (1974) reported the presence of wells completed in the valley sediments in the Main Stem Watershed. Although the water can be highly mineralized, the wells completed in the unconsolidated valley sediments can provide adequate quantities of water for domestic purposes (Norbeck 1974). Greater well yields are possible at some locations within the valley. In the Cataldo area, a municipal well with a capacity of 300 to 400 gallons per day has been in use for several years (Norbeck 1974).

Idaho Department of Water Resources water-rights records for the Main Stem Watershed indicate that seven groundwater/spring sources are used for domestic, irrigation, municipal, and commercial purposes. The records also indicate that one surface water source is used for irrigation purposes (IDWR 2000).

2.3 SURFACE WATER HYDROLOGY

The following sections describe the surface water hydrology of the main stem Coeur d'Alene River Watershed. The watershed contains approximately 9 square miles with approximately 5.7 miles of mapped channel. The watershed extends from the I-90 river crossing downstream of Cataldo to the confluence of the North and South Forks. The total drainage basin size, including the drainage area contributed by the North and South Forks, is approximately 1,223 square miles.

2.3.1 Available Information

The available hydrologic information for the main stem Coeur d'Alene River Watershed includes United States Geological Survey (USGS) stream flow data for the Coeur d'Alene River at Cataldo, climatological data for Kellogg, ID, and instantaneous discharge data obtained during water quality sampling between 1991 and 1999.

The period of record for the USGS station 12413500, Coeur d'Alene River at Cataldo, is May 1, 1911 to December 31, 1912, August 1, 1920 to September 30, 1972, and October 1, 1986 to September 30, 1999 (USGS 2000). This station records water stage at 15-minute intervals. Discharge is calculated from the stage data based on a rating curve developed for the specific gage. The rating curve is developed through time by measuring discharge at known stages to relate stage to discharge. Once a rating curve is developed, a discharge can be calculated by comparing a known stage to the rating curve. Precipitation data from the Western Regional Climate Center (WRCC) station at Kellogg, ID, have been collected for the period of February 1, 1905 to present (WRCC 2000). This precipitation gage is the nearest gage to the Coeur d'Alene River Watershed. The mean daily discharge hydrograph and precipitation data are presented in Figure 2.3.1-1 for water year 1999. The maximum discharge recorded during water year 1999 was 17,300 cubic feet per second (cfs), on May 26, 1999. The minimum recorded discharge for water year 1999 was 299 cfs on October 27, 1998. For the entire period of record, the maximum discharge reported was 67,000 cfs on December 23, 1933.

Stream discharge measurements were taken in association with water quality sampling events completed by the Idaho Division of Environmental Quality (IDEQ) and USGS at one site, LC50, in the main stem Coeur d'Alene River Watershed. These measurements have occurred between 1998 and 1999 and are summarized in Table 2.3.1-1

In addition to the USGS hydrologic information and the instantaneous discharge measurements, the U.S. Department of Housing and Urban Development, Federal Insurance Administration (FIA) completed a flood insurance study (FIS) for Shoshone County, Idaho, in 1979 (FIA 1979).

Computed peak discharges for 10-year (36,000 cfs), 50-year (60,600 cfs), 100-year (75,000 cfs) and 500-year (113,975 cfs) events for the Coeur d'Alene River at Cataldo were reported. Although these values might be dated, and coefficients used to calculate these discharges may contain some error, they do provide some basis for selecting a design discharge for remedial actions.

2.3.2 Hydrologic Description

The hydrology of the main stem Coeur d'Alene River Watershed is described below based on stream discharge measured at the Cataldo gage and precipitation data. Base flow discharge is estimated at approximately 300 to 400 cfs. The maximum discharge recorded is 67,000 cfs. These estimates are based on historical discharge data from the gage at Cataldo.

2.3.2.1 Historical Description

Continuous discharge data for the downstream end of the main stem Coeur d'Alene River Watershed consists of the data collected at the Cataldo gage dating from 1911. The historical estimates of mean daily discharge from water years 1986 to 1999 are presented in Figure 2.3.2-1. The mean daily discharge from water years 1921 to 1972 are presented in Figure 2.3.2-2. The maximum mean daily discharge is 50,000 cfs and occurred on December 23, 1933. Average annual discharge is approximately 2,500 cfs.

As can be seen in Figures 2.3.2-1 and 2.3.2-2, a wide range of discharges occur in the Coeur d'Alene River at Cataldo. Late summer and fall months typically have the smallest discharge of the year, while spring and summer months typically have the largest. The largest discharges occur during the winter months during rain on snow events. Typically, the peak annual discharge has magnitude between 10,000 and 20,000 cfs; however, these values vary significantly from year to year.

2.3.2.2 Flood Frequency

Peak annual discharge for the Coeur d'Alene River at Cataldo for the period of record were used with the USGS computer program PEAKFQ2.4 (USGS 1998) to calculate the discharge and 95 percent confidence intervals at various recurrence intervals. PEAKFQ2.4 performs the flood frequency calculations based on Bulletin 17B from the Interagency Advisory Committee on Water Data (USGS 1982). As described in Section 2.3.1, a FIS is available for Shoshone County (FIA 1979), which reports magnitudes of flooding events of various recurrence intervals. The results of these analyses are presented in Table 2.3.2-1 for the Coeur d'Alene River at Cataldo.

The bankful discharge, the approximately 1.5 year event, is estimated to be approximately 15,000 cfs.

Comparison of the estimated peak flows in the FIS and the estimates from the PEAKFQ2.4 analyses for the Coeur d'Alene River at Cataldo, Table 2.3.2-1, indicates a good correlation. All values reported in the FIS fall within the 95 percent confidence intervals calculated using PEAKFQ2.4.

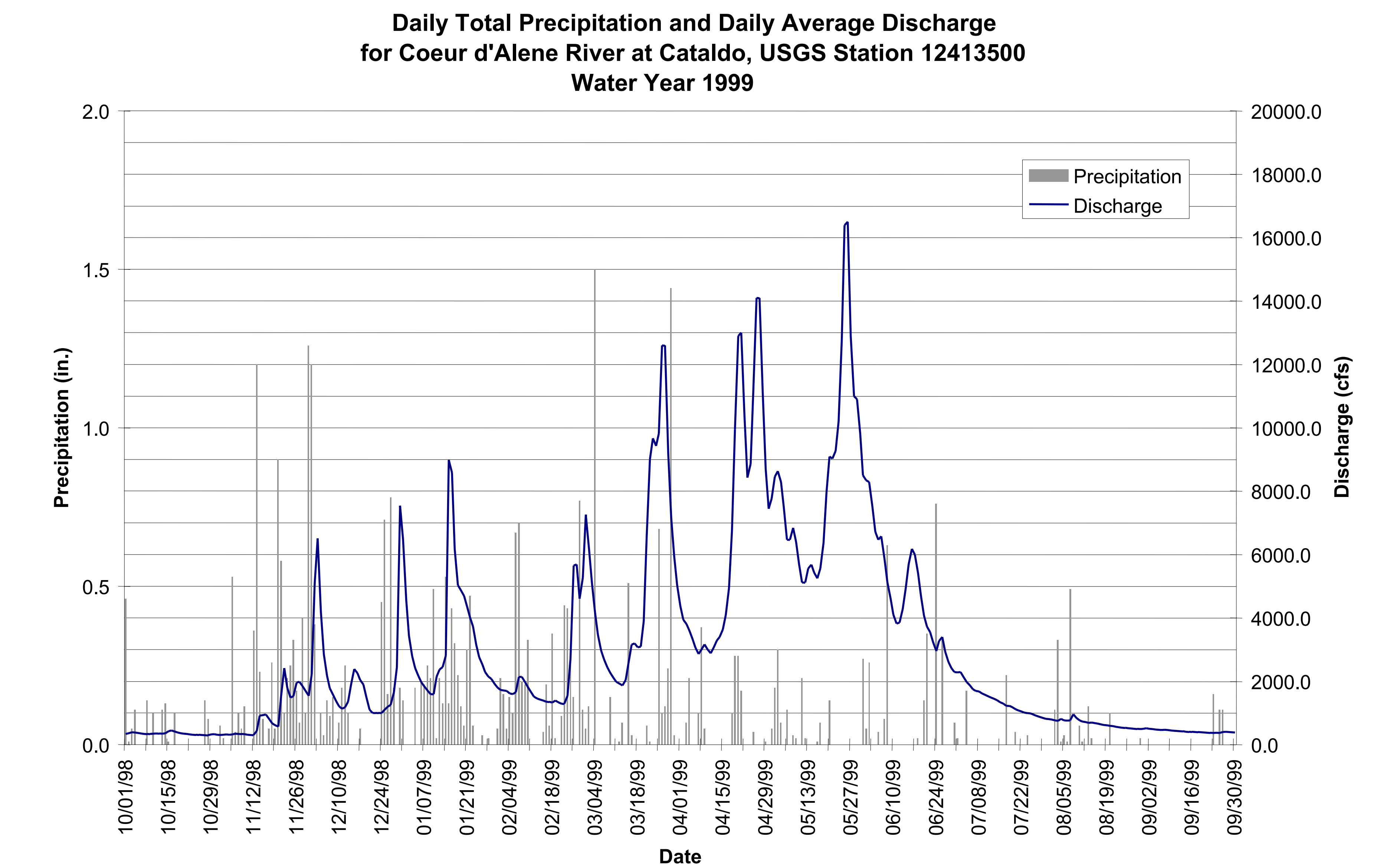
2.3.2.3 Water Year 1999

Total annual average precipitation at the WRCC Kellogg Station for the 95-year period of record is 30.8 inches, while for water year 1999 the total precipitation was 37.8 inches (WRCC 2000). Total annual average snowfall for the WRCC station is 54.3 inches, while for water year 1999 the total snowfall was 35.5. While these comparisons do not address monthly variations in precipitation, they do indicate that the water budget for water year 1999 was somewhat typical, with above average total precipitation and below average snowfall, at the Kellogg station.

Mean monthly flows for the Coeur d'Alene River at Cataldo, total monthly precipitation (rain and snow water content), and total snowfall at the WRCC station at Kellogg for water year 1999 are summarized in Table 2.3.2-2. Table 2.3.2-2 and Figure 2.3.1-1 show that the majority of precipitation occurred from October to March (78 percent of the total annual precipitation). Much of the precipitation in the upper basin was in the form of snow and did not run off into the stream channels immediately. However, increased discharge, above the average annual discharge of 2,500 cfs, occurred four times during the winter and spring months, from December 2 to December 5, from December 30 to January 3, from January 14 to January 26, and from February 24 to March 7. In contrast, during the spring and summer months, discharge at the Cataldo gage remained above the average annual discharge from March 15 to June 28. This type of drainage pattern is similar to historical flows, Figures 2.3.2-1 and 2.3.2-2, where much of the annual discharge occurs during the spring and summer, with limited periods in the fall and winter, with above average annual discharge.

The increase in discharge during the spring and summer is attributed to increased runoff caused by snowmelt in the upstream watersheds. Maximum daily temperature and mean daily discharge for water year 1999 for the Coeur d'Alene River at Cataldo are presented in Figure 2.3.2-3. Increased temperatures over these periods melted much of the snow in the upper basin. Rain on snow also may have contributed to these increased discharges as indicated in Figure 2.3.1-1 where precipitation events occurred during periods of increased temperature.

In summary, water year 1999 was typical from a total snowfall and total water budget perspective in the main stem Coeur d'Alene River Watershed. Runoff from spring snowmelt dominates the surface water hydrology, particularly in spring and summer while direct runoff of rainfall may be more pronounced during the fall. Variations in snowfall, temperature, and rainfall from year to year will influence the magnitude and timing of peak discharges.



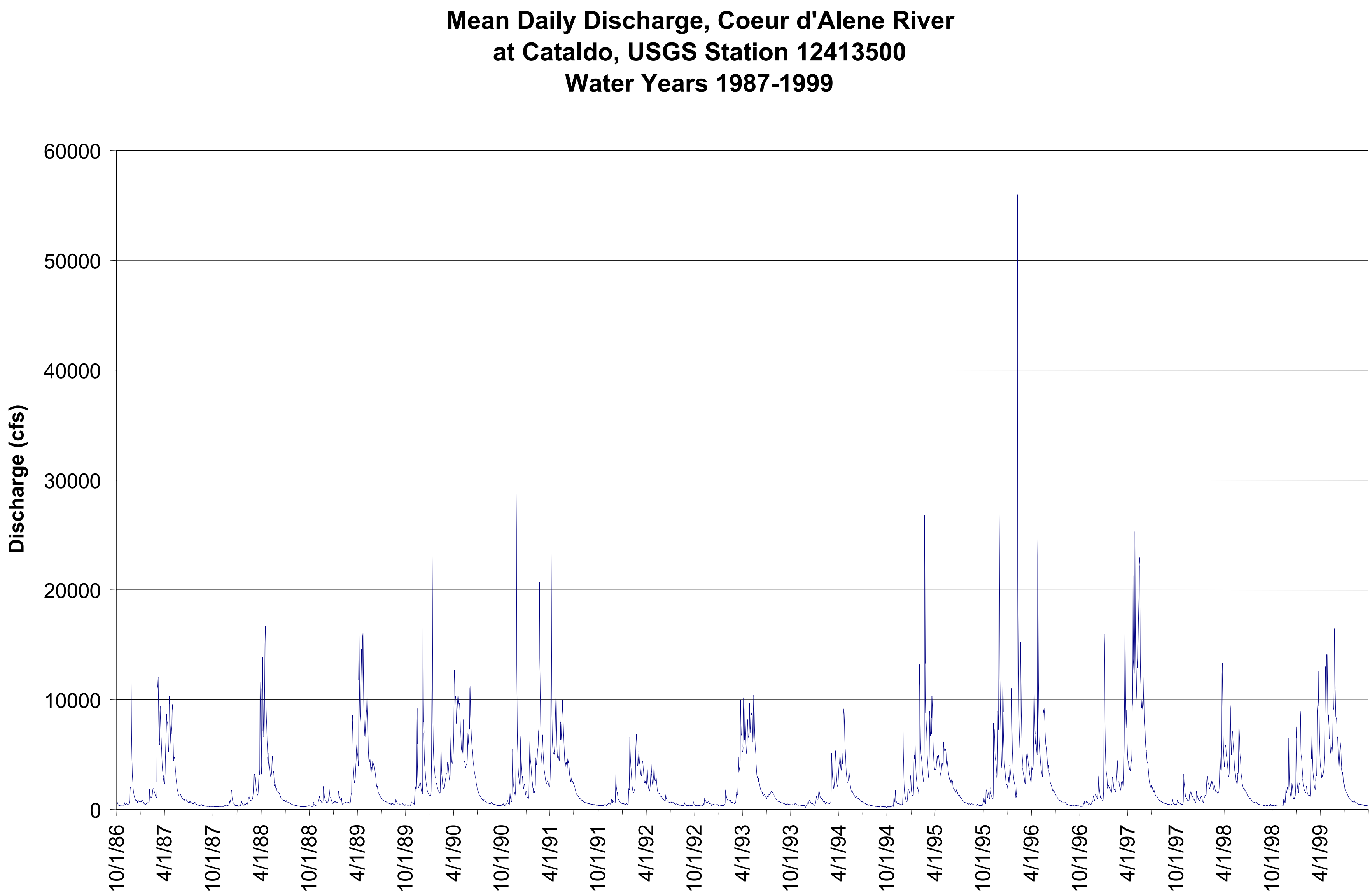
EPA REGION 10

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

Doc Control: 4162500.6615.05.a
Generation: 1

Main Stem Series
07/13/01

Figure 2.3.1-1



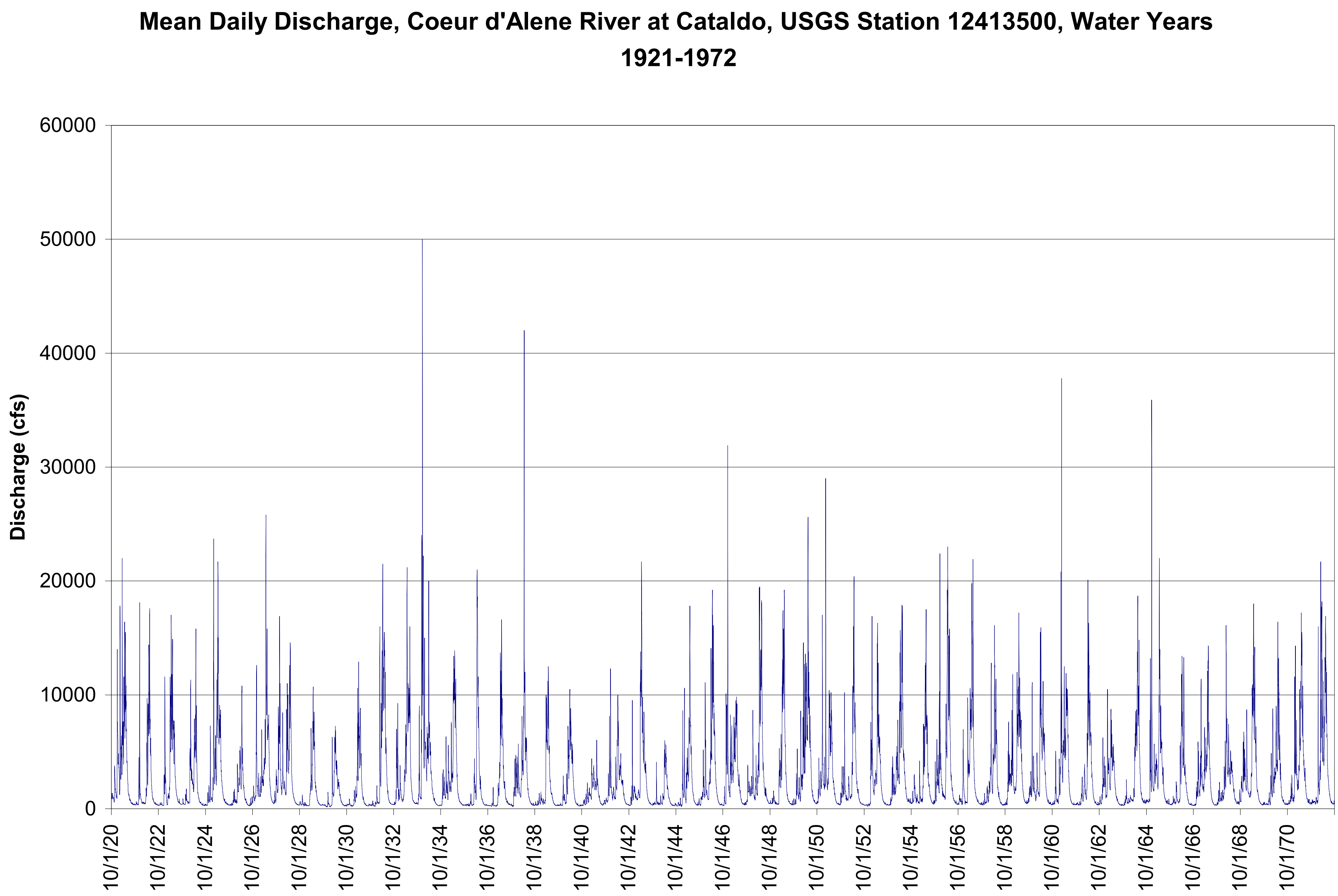
EPA REGION 10

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

Doc Control: 4162500.6615.05.a
Generation: 1

Main Stem Series
07/13/01

Figure 2.3.2-1



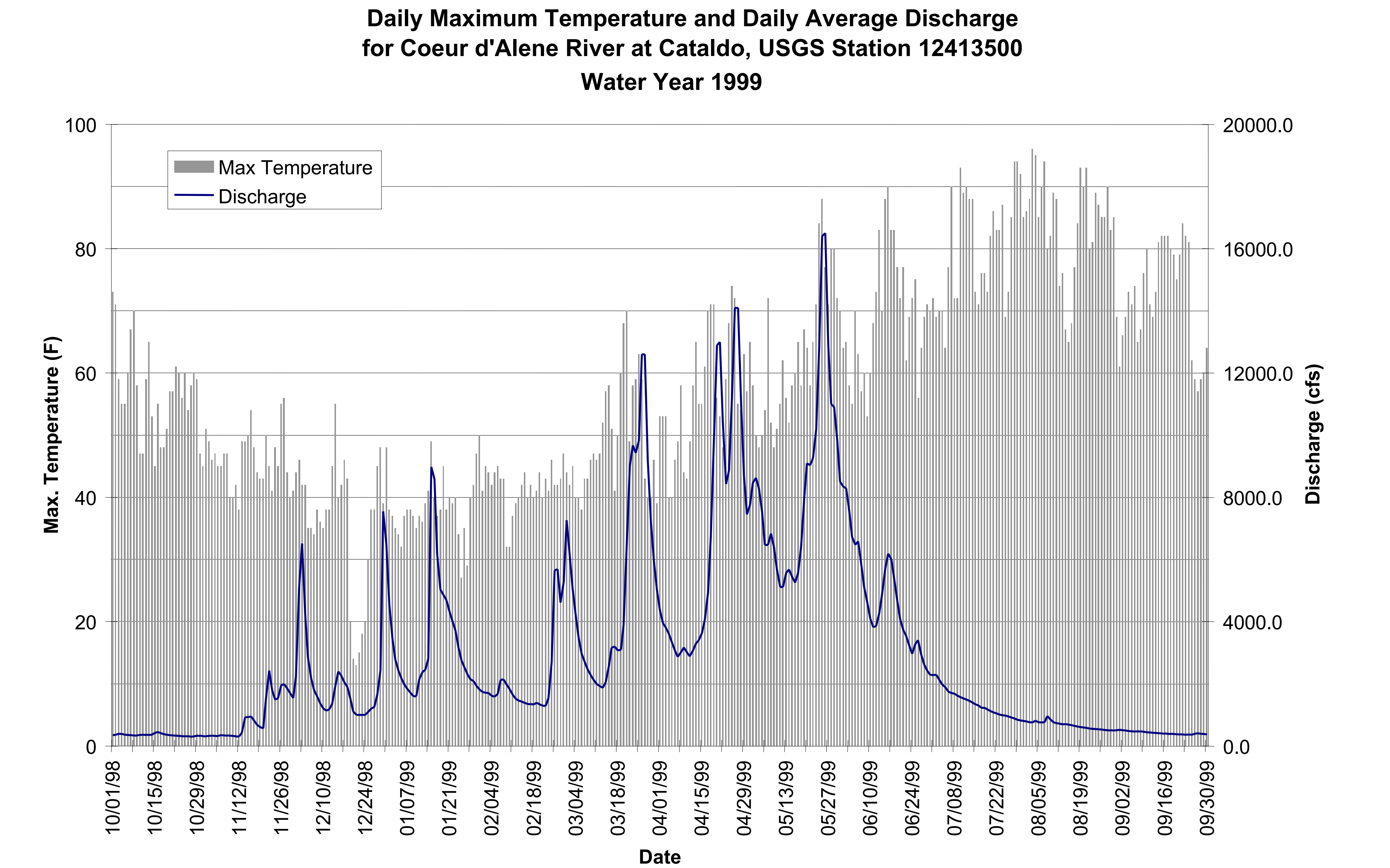
EPA REGION 10

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

Doc Control: 4162500.6615.05.a
Generation: 1

Main Stem Series
07/13/01

Figure 2.3.2-2



EPA REGION 10

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

Doc Control: 4162500.6615.05.a
Generation: 1

Main Stem Series
07/13/01

Figure 2.3.2-3

Table 2.1.6-1
Mines in Main Stem Coeur d'Alene River Watershed With Recorded Production

Segment	Production Years	Ore (tons)	Mill	Tailings (tons)	Comments
Hypotheek Mine					
MidGradSeg04	1913-1956	88,702	Hypotheek Mill	80,579	In 1914, good ore was found on 700 level and a new shaft was sunk from the surface. In 1916 the shaft was down 1100 feet, a new mill was completed and the mine was shipping ore on a regular basis. By 1921, the property was shut down and flooded, but was reopened again by 1924, when it was dewatered to the 700 level and development resumed. By 1927, the mine was dewatered to the 1100 level and mining was still underway, until 1930. From 1934 through 1938, there was limited development. The mill had a 200 ton/day capacity at that time. In 1947, the mine was again being reopened and development continued through 1953. In 1951, work was undertaken on the Pine Creek side from the King of Pine Creek property. Lateral development was done as well as opening up the old shaft at that mine. Exploration continued through 1956 when operations were suspended (SAIC 1993 - Mine Sites Fact Sheets)

Table 2.3.1-1
Summary of Discharge Data From Project Database
Segment MidGradSeg04

Segment Name	Site Location	Measured By	No. of Readings	Beginning Date	Ending Date	Minimum Discharge	Maximum Discharge	Units
MidGrad Seg04	LC 50	IDEQ, USGS	25	04/23/98	10/20/99	5	16000	cfs

Table 2.3.2-1
Estimated Recurrence Intervals, Coeur d'Alene River at Cataldo

Recurrence Interval (Years)	Estimate of Discharge (cfs) Annual Frequency Peak Flow 67 Year Period of Record	Lower 95 Percent Confidence Interval (cfs)	Upper 95 Percent Confidence Interval (cfs)	Flood Insurance Study (FIS) At Cataldo Gage Estimated Peak Flow (cfs)
2	18,700	16,900	20,600	not available
5	28,300	25,500	32,010	not available
10	35,500	31,400	41,100	36,000
25	45,400	39,400	54,300	not available
50	53,400	45,600	65,400	60,600
100	62,100	52,100	77,600	75,000

Note:
Flood insurance study (FIS) location for flooding source in Coeur d'Alene River is at Cataldo Gage.

Table 2.3.2-2
Precipitation Summary and Discharge Comparison for Water Year 1999
Kellogg, Idaho
NOAA Cooperative Station 104831

Climate Indicators	Monthly Totals												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
Total Precipitaiton (in.)	1.4	7.5	5.3	4.6	5.7	5.1	1.7	1.5	2.7	0.5	1.3	0.4	37.8
Total Snowfall (in.)	0.0	0.8	11.0	5.2	13.1	5.1	0.3	0.0	0.0	0.0	0.0	0.0	35.5
Average Precipitation for Period of Record (in.)	2.7	3.8	3.9	3.7	2.8	2.9	2.4	2.5	2.2	1.0	1.1	1.7	30.8
Average Snowfall for Period of Record (in.)	0.3	5.0	14.1	18.5	10.1	5.6	0.7	0.0	0.0	0.0	0.0	0.0	54.3
Mean Monthly Discharge (cfs) (Coeur d'Alene River at Cataldo)	350	920	2300	3320	2150	5250	6550	8420	4760	1370	660	420	3050

3.0 SEDIMENT TRANSPORT PROCESSES

The main stem Coeur d'Alene River Watershed (segment MidGradSeg04) extends from the I-90 crossing of the Coeur d'Alene River downstream from Cataldo to the confluence of the North Fork and South Fork of the Coeur d'Alene River. Sediment derived in the North and South Forks is transported to the upstream end of segment MidGradSeg04. Within segment MidGradSeg04, some sediment may be deposited; however, based on review of aerial photographs, much if not all of this sediment is transported through the segment to lateral lakes area. Sediment sources in this segment are sediment derived from the North and South Forks, mining wastes, channel bed sediment, bank erosion, and lateral migration of the channel. In this discussion, the available information, analyses, and likely sediment sources are described.

3.1 AVAILABLE INFORMATION

Sediment transport data are not available for areas within segment MidGradSeg04. However, sediment transport information is available from the Coeur d'Alene River at Rose Lake, approximately 7.7 miles downstream of segment MidGradSeg04.

In addition to the sediment gaging data for the Coeur d'Alene River at Rose Lake, historical and current aerial photographs are available. Photographs taken in 1998 by URS Greiner, Inc. (URSG) (URSG and CH2M HILL 1999) and 1984 and 1991 photographs by U.S Department of Agriculture (USDA) (USDA 1984, 1991) were reviewed.

3.2 ANALYSES

3.2.1 USGS Sediment Gaging Data

The Coeur d'Alene River between the downstream end of segment MidGradSeg04 and the gaging station at Rose Lake winds through approximately 7.7 miles of channel. The channel width is relatively constant and banks appear to be relatively stable. No major sediment sources except minor bank erosion are evident between the Rose Lake gaging station and the downstream end of segment MidGradSeg04. Several exposed gravel bars extend approximately one mile downstream of the end of segment MidGradSeg04. In addition, the Cataldo dredge site is located approximately 2 miles downstream of the end of segment MidGradSeg04. The Cataldo dredge site was created to remove sediment from the river and to prevent additional mill tailings and river silt from moving further down river (Grant 1952). Deposition, particularly coarse sand and gravel, is likely at the gravel bars and dredge site. Fine sands and silts likely pass through the 7.7 miles of channel to the Rose Lake gaging station. The magnitude of suspended sediment transport at the Rose Lake gaging station is likely similar to or less than the suspended load at the downstream end of MidGradSeg04 due to decreased channel slope. Segment MidGradSeg04 transports larger material as bedload than the Rose Lake gaging station, as much of the larger particles are deposited within segment MidGradSeg04.

Estimates of the magnitude of suspended sediment transport at the Rose Lake gage based on transport data collected by USGS indicate approximately 6,700 tons of sand, and 23,000 tons of fines were transported during water year 1999. Similar magnitudes would be expected in segment MidGradSeg04. Bedload transport data were not collected at the Rose Lake gage. Further discussion of sediment transport at the Rose Lake gage is provided in the Lower Coeur d'Alene River (CSM Unit 3) Remedial Investigation report.

3.2.2 Channel Classification

Channel classifications may provide a level of understanding and description of a channel's behavior. Some channel classification systems require fieldwork and in depth study while others only require topographic map and aerial photograph interpretation. The level of information provided by a classification based solely on topographic map and aerial photograph interpretation is limited but does provide a basic framework for channel processes and conditions.

Rosgen and Silvey (1996) proposed a classification method that delineates channel types based on plan-view morphology, cross-section morphology, channel sinuosity, channel slope, and bed features to provide a broad level delineation. Aerial photograph and topographic map interpretation can be used for this type of classification, Level 1. The Rosgen methodology builds from this broad classification when combined with more detailed information. The Rosgen Level 1 classification was used for this study to identify broad reach level channel morphologies.

Electronic United States Geological Survey (USGS) 7 ½ minute quadrangle maps containing three dimensional topographic data were analyzed using AutoCAD Land development software. Plots of channel profile and slope were produced for segment MidGradSeg04, Figures 3.2-1 to 3.2-2. Segment MidGradSeg04 contains only one type of channel. The channel type was determined based on channel slope and observation of aerial photographs from 1998. Further description of the aerial photographs and topographic maps, current and historical, is contained in Section 3.2.3.

Channel stationing was established from the I-90 river crossing at Cataldo at 100-foot stations upstream to the confluence of the North and South Forks for ease of locating specific features. This stationing is indicated on Figures 3.2-1 and 3.2-2. This stationing is approximate and is intended for general locating of discussed areas, more detailed stationing and survey should be used for precise locating, and project construction.

In the main stem Coeur d'Alene River Watershed, one Rosgen stream type occurs, "D." "D" stream types consist of braided channels exhibiting multiple channels with bars developed throughout the channel. Sediment supply in "D" stream channels is very high or unlimited. Bank erosion rates are high. Changes in channel position commonly occur as portions of the channel are eroded and deposition occurs at other locations. These changes in channel locations can be caused by either natural or anthropogenic forces.

The channel type within segment MidGradSeg04 is identified on the topographic map, Figure 3.2-1. The entire reach of segment MidGradSeg04 contains braided channels indicating high sediment supply. Significant deposition may occur throughout this reach as well as erosion of previously deposited sediment.

3.2.3 Channel Descriptions

The 1998 set of aerial photographs by URS Greiner and CH2MHILL, the 1991 and 1984 aerial photographs by USDA, and the topographic map and profile presented in Figure 3.2-1 were reviewed to further describe segment MidGradSeg04. The 1984 aerial photographic coverage extended from station 275+00 to 300+00, the 1991 coverage extended from 115+00 to 300+00, and the 1998 coverage extended from 0+00 to 300+00. This review and interpretation focused on morphologic features indicating stream instability, channel migration, channel aggregation or degradation and other features that may contribute sediment to the system. These features are mapped on Figure 3.2-1.

The main stem Coeur d'Alene River Watershed has approximately 30,000 feet (5.7 miles) of channel as indicated on Figure 3.2-1. Channel slope is relatively flat, varying from 0.12 to 0.16 percent. Segment MidGradSeg04 is largely a zone of sediment deposition as higher gradient tributaries flow into the lower gradient main stem.

From station 0+00 to 4+00, the channel is constrained in position by I-90 and secondary road bridge structures. The channel is approximately 300 feet wide, and the only likely sources of sediment are channel bed remobilization and minor bank erosion.

From station 4+00 to 72+00, the Coeur d'Alene River occupies a valley ranging in width from 500 to 1,400 feet with the main channel occurring 100 to 200 feet of the width. Relict channels are apparent in the 1998 photographs. A pond with no apparent low flow surface water outlet is situated in the floodplain adjacent to the channel. The floodplain is moderately covered with trees and other vegetation indicating the area is generally stable from erosion. The occurrence of relict channels suggests that lateral migration may contribute sediment to the system during high flow events. In addition, channel bed remobilization and minor bank erosion are likely sediment sources in this reach.

The Coeur d'Alene River from station 72+00 to 96+00 is confined to an effective valley width of approximately 500 feet by hillslopes and a railroad embankment. The main channel is 100 to 200 feet wide. Relict channels and multiple channels are apparent in the 1998 photographs. The floodplain is sparsely vegetated with exposed sediment evident adjacent to the channel. Likely sediment sources in this reach are lateral migration, channel bed remobilization, and minor bank erosion.

From station 96+00 to 116+00, the Coeur d'Alene River is constrained in a well defined single thread channel by a hillslope on the south and a well vegetated bank on the north. No obvious sign of erosion, deposition, or migration is apparent in the 1998 photographs. Channel bed remobilization and minor bank erosion are the only likely sediment sources in this reach.

The Coeur d'Alene River from station 116+00 to 185+00 is located in a single channel; however, relict channels are apparent in the 1991 and 1998 photographs. Large gravel bars with little or no vegetation are deposited along the channel margins throughout this reach; however, from station 166+00 to 174+00, a lateral gravel bar is heavily vegetated with trees. The likely sediment sources in this reach are channel migration, channel bed remobilization, and minor bank erosion.

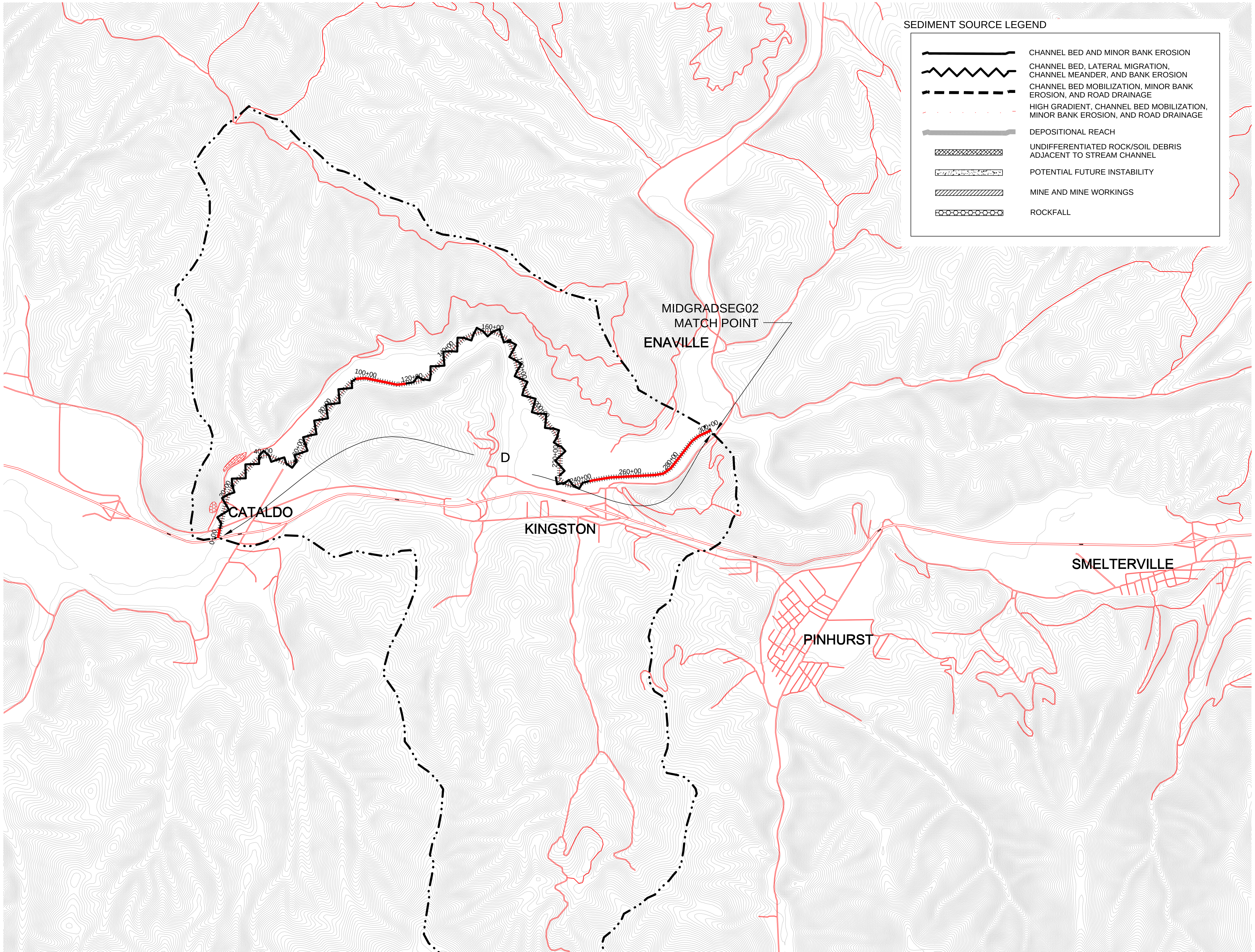
From station 185+00 to 242+00, the Coeur d'Alene River is heavily braided with multi-threaded channels. The multiple channels span the width of the valley, 1000 to 2000 feet. Numerous relict channels and ponds cover much of the valley bottom. The southwest portion of this reach is well vegetated and the northeast portion is sparsely vegetated. The vegetation in 1998 appears larger in the 1998 photographs than in the 1991 photographs. Sediment sources in this reach are likely lateral migration, channel bed remobilization, and minor bank erosion.

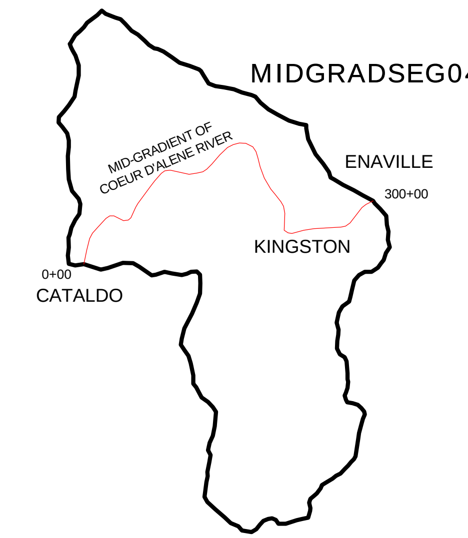
From station 242+00 to 300+00, the confluence of the North and South Forks, the channel alignment is generally in one channel 200 to 300 feet wide, constrained by a roadway embankment on the south and southeast banks. The north and northwest banks are well vegetated with trees. A side channel on the north side of the main channel flows through the vegetated floodplain. Fifty-foot-wide gravel bars have formed on the inside of bends through this reach. Likely sediment sources in this reach are channel bed remobilization and minor bank erosion.

3.3 SUMMARY

Segment MidGradSeg04 appears to have large quantities of sediment transported through it, indicated by the braided nature of much of the channel length. The sediment sources are sediment derived in and transported by the North and South Forks. Point sources of sediment in segment MidGradSeg04 sediment were not observed in the photographs reviewed. Sediment is generated in this segment from channel migration, bed remobilization and minor bank erosion.

Figure 3.2-1
Mid Gradient Segment 04 Site Plan





LEGEND

- BASIN BOUNDARY
- CONTOUR LINE
- CHANNEL CENTERLINE
- INTERSTATE/ROAD/TRAIL
- Aa+ ROSGEN CLASSIFICATION

NOTES:

1. MAP FEATURES AND CONTOURS PRODUCED BY AMERICAN DIGITAL CARTOGRAPHY, COPYRIGHT 1995, AND BASED ON 7.5 MINUTE SERIES MAPS, REVISED 1977, ZONE ID-W.
2. VERTICAL DATUM BASED ON NAD83 IDAHO STATE PLANE COORDINATE SYSTEM.
3. CONTOUR INTERVAL IS 25 FEET.
4. CHANNEL CENTERLINE TAKEN AT APPROXIMATE LOW POINT OF STREAM CHANNEL.
5. SEDIMENT SOURCE LOCATIONS ARE APPROXIMATE AND ARE BASED ON TOPOGRAPHIC MAP AND AERIAL PHOTOGRAPH INTERPRETATION.

N
W E
S

0 4000 8000
Scale in Feet

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI Report

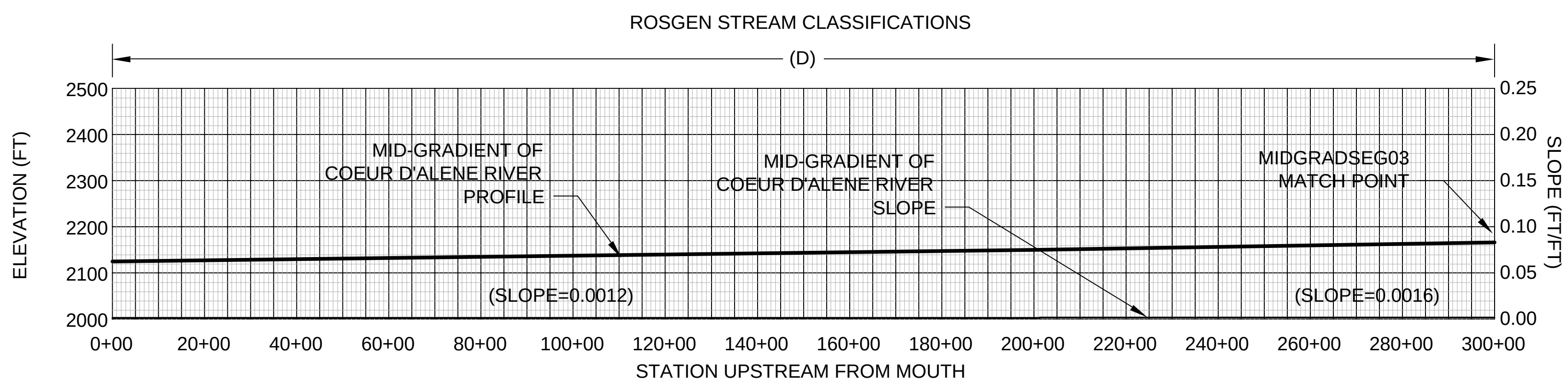
EPA
REGION 10

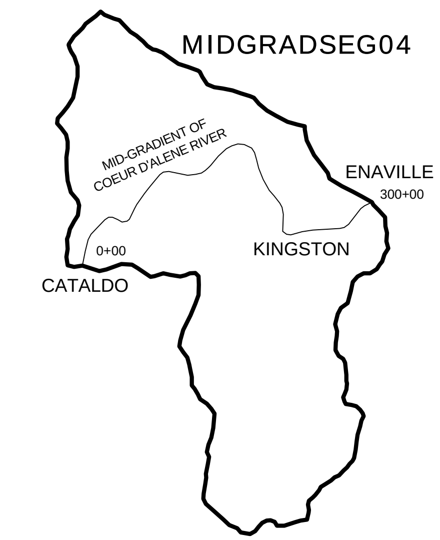
Doc Control 41625.6615.05.a
Generation: 2
N:\Coverages\OTHERS\Shannon&Wilson\MidGrad\MidGrad4_Site.dwg
Layout: MIDGradSeg04
7/17/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: July 17, 2001

Figure 3.2-2
Mid Gradient Segment 04 Section
Rosgen Stream Classification





LEGEND

SEGMENT PROFILE

SEGMENT SLOPE

NOTES:

1. CHANNEL PROFILE AND SLOPES ARE APPROXIMATE AND BASED ON MAP PRODUCED BY AMERICAN DIGITAL CARTOGRAPHY, COPYRIGHT 1995, AND BASED ON 7.5 MINUTE SERIES MAPS, REVISED 1977, ZONE ID-W.
2. VERTICAL DATUM BASED ON NAD83 IDAHO STATE PLANE COORDINATE SYSTEM.
3. DRAINAGE AREAS ARE APPROXIMATE AND MAY NOT BE LINEAR AS INDICATED BY PLOT.

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI Report

EPA REGION 10

Doc Control 41625.6615.05.a
Generation: 2
N:\Coverages\OTHERS\Shannon&Wilson\MidGrad\MidGrad4_Section.dwg
Layout: MIDGradSeg04
7/17/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: July 17, 2001

4.0 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination and mass loading in the Main Stem Coeur d'Alene River are discussed in this section. Section 4.1 describes chemical concentrations found in environmental media, including horizontal and vertical extent. For each watershed segment, the discussion includes remedial investigation data chemical analysis results; comparison of chemical results to selected screening levels (Part 1, Section 5.1); and focused analysis of identified source areas. In Section 4.2, preliminary estimates of mass loading are presented.

4.1 NATURE AND EXTENT

The nature and extent of the ten metals of potential concern identified in Part 1, Section 5.1 (antimony, arsenic, cadmium, copper, iron, lead, manganese, mercury, silver, and zinc) in surface soil, subsurface soil, sediment, groundwater and surface water are discussed in this section. Locations with metals detected in any matrix at concentrations 1 times (1x), 10 times (10x) and 100 times (100x) the screening level were identified and presented in the following data summary tables. The magnitudes of exceedence (10x and 100x) were arbitrarily selected to delineate areas of contamination.

Historical and recent investigations at areas within the study area are listed and summarized in Part 1, Section 4.0. Data source references are included as Attachment 1. Chemical data collected in the Main Stem Coeur d'Alene River and used in this evaluation are presented in Attachment 2. Data summary tables include sampling location, data source reference, collection date, depth, and reported concentration. Screening level exceedences are highlighted. Sampling locations are shown on Figures 4.1-1 and 4.1-2.

The nature and extent of contamination were evaluated by screening chemical results against applicable risk-based screening criteria and available background concentrations. Screening levels are used in this analysis to identify source areas and media (e.g., soil, sediment, groundwater, and surface water) of concern that will be evaluated in the Feasibility Study.

Statistical summaries for each metal in surface soil, subsurface soil, sediment, groundwater, and surface water are included as Attachment 3 and discussed in the subsections below. The summaries include the number of samples analyzed; the number of detections; the minimum and maximum detected concentrations; the average and coefficient of variation; and the screening level (SL) to which the detected concentration is compared. Proposed screening levels were compiled from available federal numeric criteria (e.g., National Ambient Water Quality Criteria), regional preliminary remediation goals (PRGs) (e.g., U.S. EPA Region IX PRGs), regional baseline or background studies for soil, sediment, and surface water, and other guidance documents (e.g., National Oceanographic and Atmospheric Administration freshwater sediment screening values). The screening level selection process is discussed in detail in Part 1, Section 5.1.

Source areas within the Main Stem Coeur d'Alene River are presented in Table 4.1-1. These sites are based on source areas initially identified by the BLM (1999) and further refined by CH2MHILL and URS during the RI/FS process. The table includes source area names, source ID, source area acres, description, number of samples by matrix type, and metals exceeding 10x and 100x the screening levels in surface soil, subsurface soil, sediment, groundwater, and surface water. This table reflects source area descriptive measurements initially generated in the CSM and subsequently refined by the FS.

It should be noted that the number of samples identified for each source area was determined using the project Geographical Information System. Only sampling locations located within a source area polygon (shown on Figures 4.1-1 and 4.1-2) are included in Table 4.1-1; therefore, there may be samples collected from source areas and listed in the data summary tables in Attachment 2 that are not accounted for in Table 4.1-1.

The following sections present segment-specific sampling efforts and results according to matrix type. Given the extensive geographic range of the Coeur d'Alene Basin, sampling efforts were focused on areas of potential concern; therefore, more samples were collected from known mining-impacted areas near the creek, than from other areas within the watershed.

4.1.1 Segment MidGradSeg04

4.1.1.1 Surface Soil

Thirteen surface soil samples were collected from a depth of 0 to 0.5 feet and analyzed for total metals. Lead exceeded 10x the screening level at eleven of these sampling locations. Zinc also exceeded 10x the screening level at one sampling location.

4.1.1.2 Subsurface Soil

Twelve subsurface soil samples were collected in MidGradSeg04 from depths greater than 0.5 feet and analyzed for lead. Four of these samples were found to have lead concentrations greater than 10x the screening level.

4.1.1.3 Sediment

Twenty-three sediment samples were collected and analyzed for total metals. Antimony, arsenic, cadmium, lead, manganese, mercury, and zinc were detected at concentrations greater than 10x the screening level at several locations. The concentration of lead at three locations exceeded 100x the screening level.

4.1.1.4 Surface Water

Forty-five surface water samples for total metals and one hundred and five surface lead and zinc. Results for the dissolved metals showed concentrations of cadmium and zinc exceeding 10x the screening levels.

4.1.1.5 Identified Source Areas

Chemical data for surface soil, subsurface soil, sediment, groundwater, and surface water were reviewed together to identify source areas within segment MidGradSeg04 that may be significant contributors of metals to the Main Stem Coeur d'Alene River. Summary source area data are presented in Table 4.1-1. Five source areas are located in this segment. No samples were collected at these sites.

4.2 SURFACE WATER MASS LOADING

In Part 1 of this report, (Setting and Methodology, Section 5.3.1), the concept of mass loading and its use in the remedial investigation was presented. Section 4.2 of the Canyon Creek Nature and Extent further discussed the use of the plotting discrete sampling events versus the probabilistic analysis of the mass loading data in Fate and Transport.

This section presents the discrete mass loading measurements made during several low- and high-flow sampling events. The locations sampled during each event are plotted on a map of the watershed (Figures 4.2-1 through 4.2-8). Each sampling location shows the cumulative mass loading of lead or zinc and the difference in mass load from the next upstream location. The difference in mass load is indicated on the maps by the term "delta." The events were selected to show variations in mass loading throughout the stream system relative to source areas. The events selected are not intended to represent all the available mass loading data. The remainder of this section presents the indicator metal correlation and selected maps with a discussion of discrete sampling events on a watershed basis.

4.2.1 Indicator Metal Correlation

In Section 4.2 of the Canyon Creek Watershed Nature and Extent, the correlation of chemical concentrations for 8 COPCs are evaluated for total lead and dissolved zinc. These two metals appear to be reasonable indicators of the other chemicals of potential concern. The following mass loading discussion is limited to total lead and dissolved zinc.

4.2.2 Main Stem Watershed Mass Loading

Of the available sampling data, four sampling events were selected and mapped. Table 4.2-1 summarizes the sampling events, sampling locations and calculated mass loads for total lead and dissolved zinc. The sampling events used were November 1997 (Figures 4.2-1 and 4.2-5), November 1998 (Figures 4.2-2 and 4.2-6), May 1998 (Figures 4.2-3 and 4.2-7) and May 1999 (Figures 4.2-4 and 4.2-8). Data from these sampling events is summarized in Table 4.2-1.

The May 1999 event was a USGS high-flow synoptic sampling effort. The results differ from previous sampling in that the overall total lead mass loading is higher than the dissolved zinc mass loading. This difference may indicate that during the high-flow synoptic event, the USGS was able to obtain water samples that better represent the average total lead concentrations in surface water. If this is the case, then historical total mass loading estimates in the basin during high flow may be biased low. For continuity and to illustrate the increase in loading from the Bunker Hill Superfund Site (BHSS), Figures 4.2-4 and 4.2-8 include all the USGS sampling locations downstream of Canyon Creek and upstream of Coeur d'Alene Lake. The data compiled in Table 4.2-1 for the synoptic sampling event uses Table 1 in the USGS administrative report (USGS 2000).

In segment MidGradSeg04, the only sampling location is LC50. This location is downstream of the confluence of the North Fork and South Fork. The North Fork is not considered a substantial loader of lead or zinc to the system when compared to the South Fork at Pinehurst. However, it does contribute a substantial volume of water to the main stem. As shown in Table 4.2-1, during the November 1998 sampling event the North Fork discharge was about 3.8 times higher than the

South Fork Flow at SF271. During the USGS May 1999 sampling event, the North Fork discharge was about 2.3 times higher than the South Fork at sampling location SF271.

The following sections discuss observations made from plotting the low- and high-flow mass loading data.

4.2.2.1 Total Lead Mass Loading

Loading observations are as follows:

As shown in Table 4.2-1 and on Figures 4.2-1 and 4.2-2 (the November 1997 and November 1998 low-flow sampling events), the total lead mass load decreased at sampling location LC50. Comparing the two sampling events shows that while the flows were similar, the magnitude of the difference in mass loading in November 1997 was much higher, at -1,063 pounds per day. The November 1998 difference in mass loading for lead was -18 pounds per day. This difference appears anomalous and the lead concentrations of 611 µg/L in November 1997 may be biased high.

The high-flow event of May 1998 (Figure 4.2-3), shows that LC50 had a total lead load of 1,545 pounds per day. The increase at LC50 is 1,145 pounds per day (the North Fork was not sampled). The USGS synoptic sampling event in May 1999 (Figure 4.2-4) indicates that total lead loading at sampling location LC50 was 20,057 pounds per day. The increase at LC50 is 1,952 pounds per day. The magnitude of this loading represents a substantial increase from historical loading estimates and may have been affected by upstream construction at the BHSS.

4.2.2.2 Dissolved Zinc Mass Loading

Loading observations are as follows:

As shown in Table 4.2-1 and on Figures 4.2-1 and 4.2-2 (the November 1997 and November 1998 low-flow sampling events), the dissolved zinc mass load increased at sampling location LC50. Comparing the two sampling events shows that the flows were similar, and the magnitudes of the loading differences were similar. The November 1998 zinc difference was 333 pounds per day and the November 1997 zinc difference was 405 pounds per day.

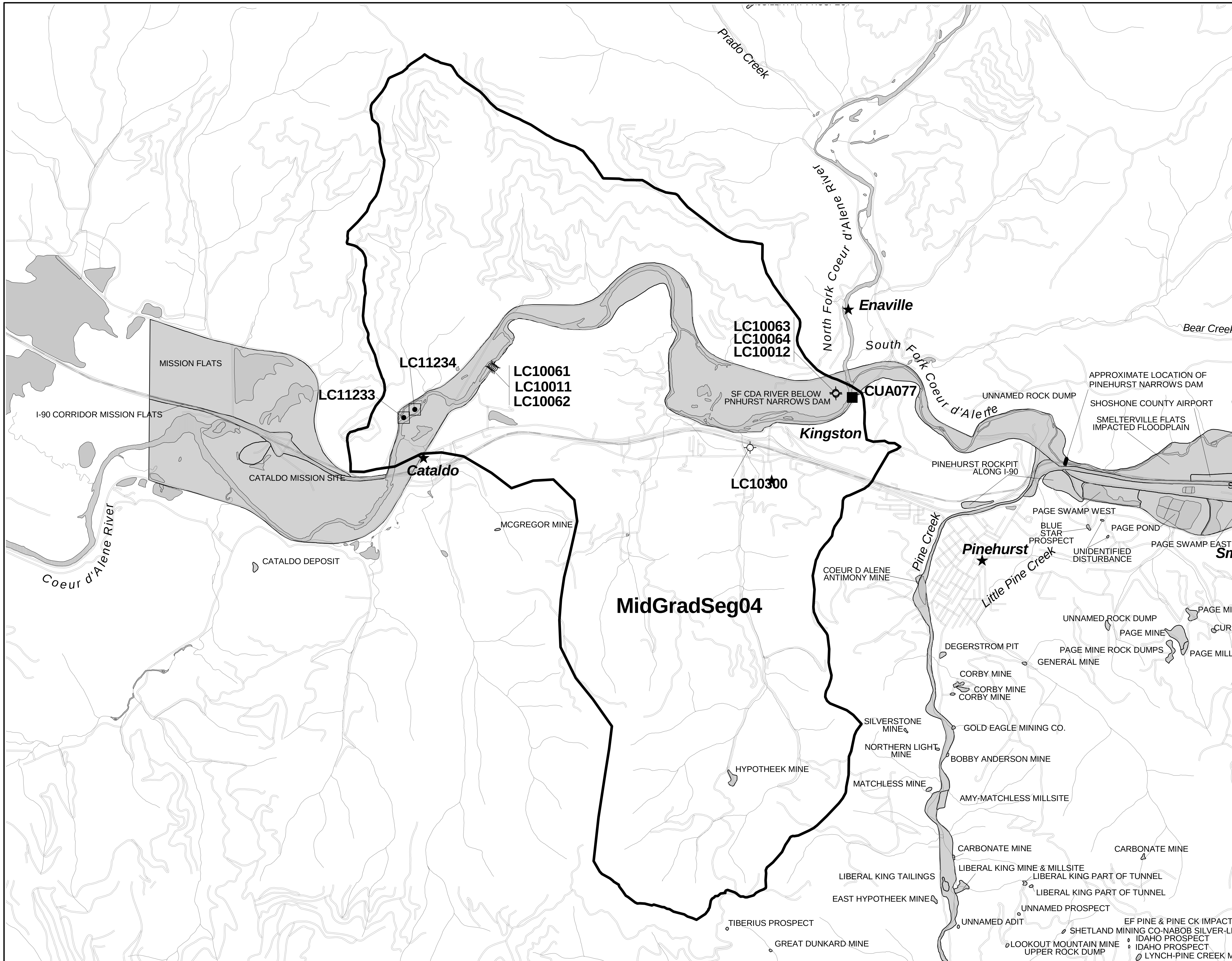
The high-flow event of May 1998 (Figure 4.2-3), shows that LC50 had a dissolved zinc load of 6,054 pounds per day. The increase at LC50 is 1,456 pounds per day (the North Fork was not sampled). The USGS synoptic sampling event in May 1999 (Figure 4.2-4) indicates that zinc loading at sampling location LC50 was 5,767 pounds per day. The increase at LC50 is 358 pounds per day. There is an increase in loading through the BHSS of 2,541 pounds per day.

4.2.2.3 Groundwater Mass Loading

The mass loading of metals from mining activities to groundwater throughout the South Fork is expected to be high. As shown in the discrete sampling events, wide variations in total lead and dissolved zinc mass loading differences exist. The USGS seepage study of the Osburn Flats area investigated the nature of the losses and gains in detail. Their study encompassed roughly only 10 percent of segments MidGradSeg01 and MidGradSeg02. The USGS study demonstrated that there are large exchanges in mass load between surface water and groundwater.

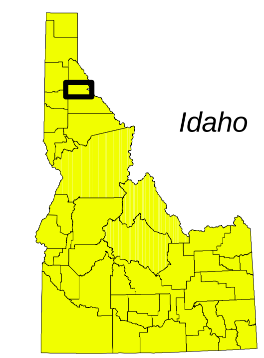
The hydrologic and wetland systems in the vicinity of the Cataldo Flats were investigated by Chamberlain and Williams (1998) to assess the role of natural wetlands in metals removal. The Cataldo Flats are covered by tailings and sediments that were deposited by or dredged from the Lower Coeur d'Alene River. Groundwater and surface water hydraulics as well as water quality were monitored. They reported that the floodplain and riverbank groundwater is recharged primarily by precipitation infiltration which is continuously dissolving large concentrations of cadmium, lead, and zinc out of the dredge spoils and into the river.

Figure 4.1-1
Coeur d' Alene River
MidGradient River Segment MidGradSeg04
Source Areas and
Soil/Sediment Sampling Locations



LEGEND

- Common Use Area Sampling Location
- River Sampling Location
- Floodplain Sampling Location
- Stream
- Interstate 90
- Road
- City
- MidGradient River Segment 4
- Source Area and Name
- River/Lake/Floodplain



Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner, Inc., CH2M HILL, and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner, Inc. Technical Data Management database as of 3/29/00.

SCALE 1:48,000

0 0.5 1 Miles

027-RI-CO-102Q
Coeur d' Alene Basin RI/FS
RI REPORT

EPA REGION 10

Doc Control 4162500.6615.05.a
Generation 1
n:\Projects\RI_FS\Midgrad|midgrad01_10-17.apr
V:Midgrad04 Soil
E:Soil
L: Final RI MGSeg04 Soil
7/16/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: JULY 16, 2001

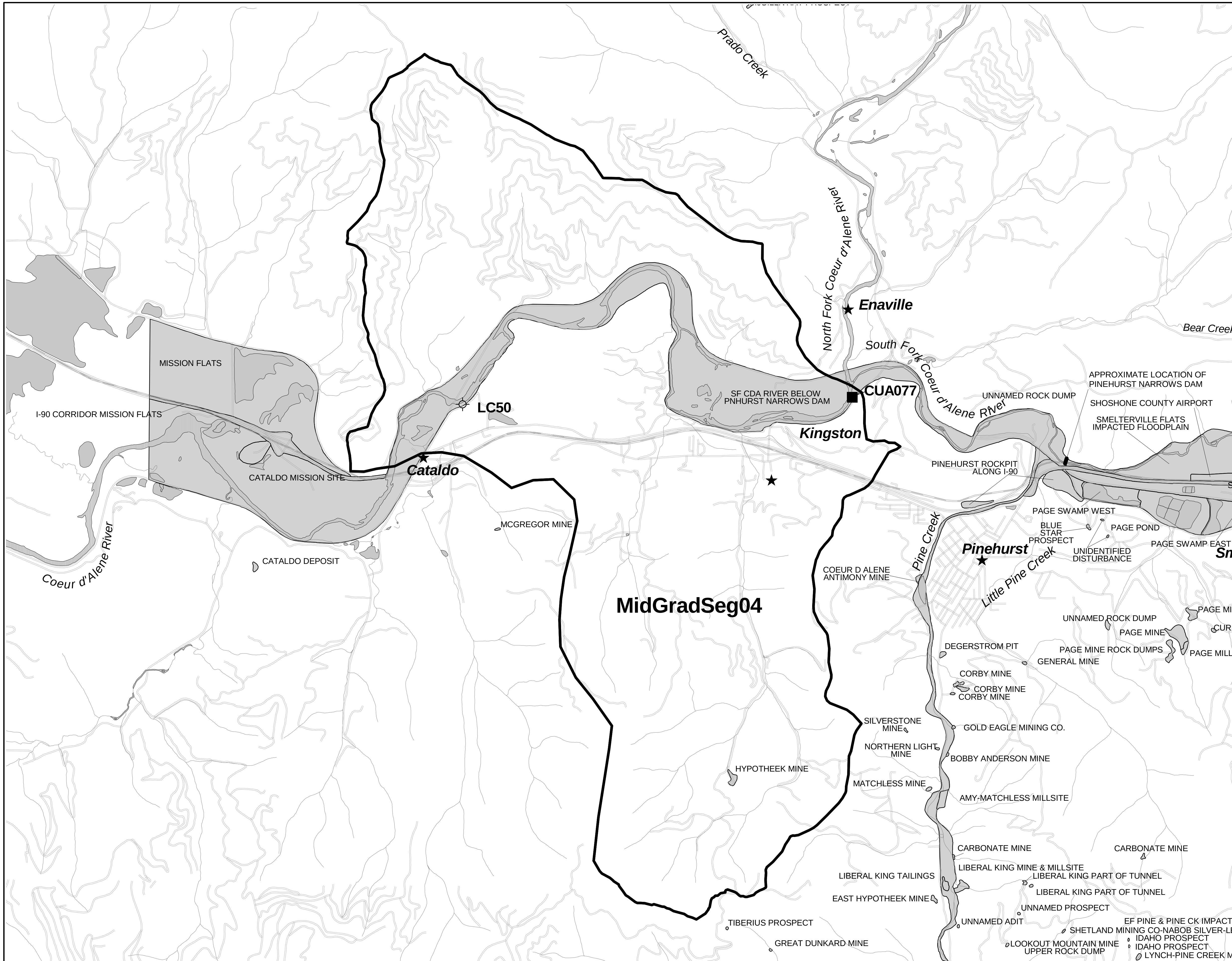
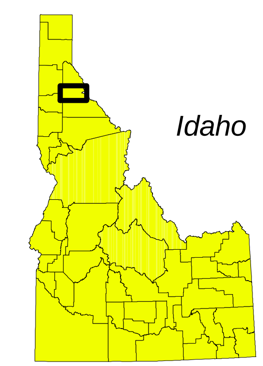


Figure 4.1-2
Coeur d' Alene River
MidGradient River Segment MidGradSeg04
Source Areas and
Surface Water Sampling Locations

LEGEND

- Common Use Area Sampling Location
- River Sampling Location
- Stream
- Interstate 90
- Road
- City
- MidGradient River Segment 4
- Source Area and Name
- River/Lake/Floodplain



Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner, Inc., CH2M HILL, and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner, Inc. Technical Data Management database as of 3/29/00.

SCALE 1:48,000

0 0.5 1 Miles

N

027-RI-CO-102Q
Coeur d' Alene Basin RI/FS
RI REPORT

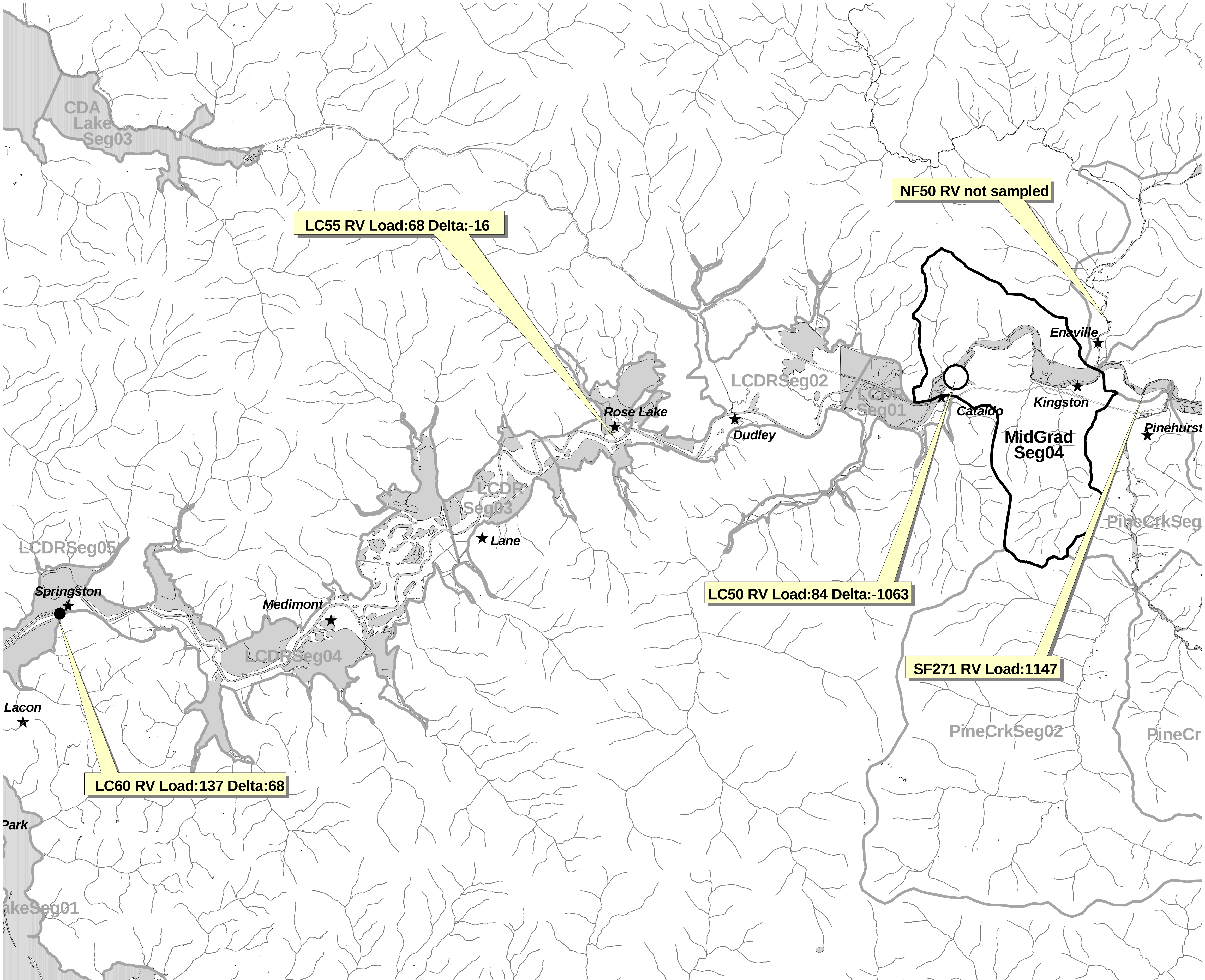
EPA REGION 10

Doc Control 4162500.6615.05.a
Generation 1
n:\Projects\RI_FS\Midgrad\midgrad01_10-17.apr
V:Midgrad04 SW
E:SW
L Final RI MGSeg04 SW
7/16/01

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: JULY 16, 2001

Figure 4.2-1
Main Stem Coeur d' Alene River Watershed
Total Lead Mass Loading
Sampling Results Nov. 1997



LEGEND

Sampling Location — LC55 RV Load: 68 Delta: -16 — Values are lbs/day

Location Type:
RV: River/Stream Sampling Location

(-) Neg.	(+) Pos.	Delta of Mass Load Compared to Preceeding Upstream Sampling Location
		Delta Range: 0 - 0.9
		Delta Range: 1 - 20
		Delta Range: 20 - 40
		Delta Range: 40 - 100
		Delta Range: 100 - 150
		Delta Range: > 150

Stream
Interstate 90
City
River/Lake
Main Stem Coeur d'Alene River Watershed
River Segment
Source Area

Location Map

NOTES

1) Base map coverages obtained from the Coeur d' Alene Tribe, URS Greiner Inc., CH2M HILL, and the Burueau of Land Management.

SCALE 1: 136,000

0 3 Miles

N

027-RI-C0-102Q
Coeur d' Alene RI/FS
RI Report

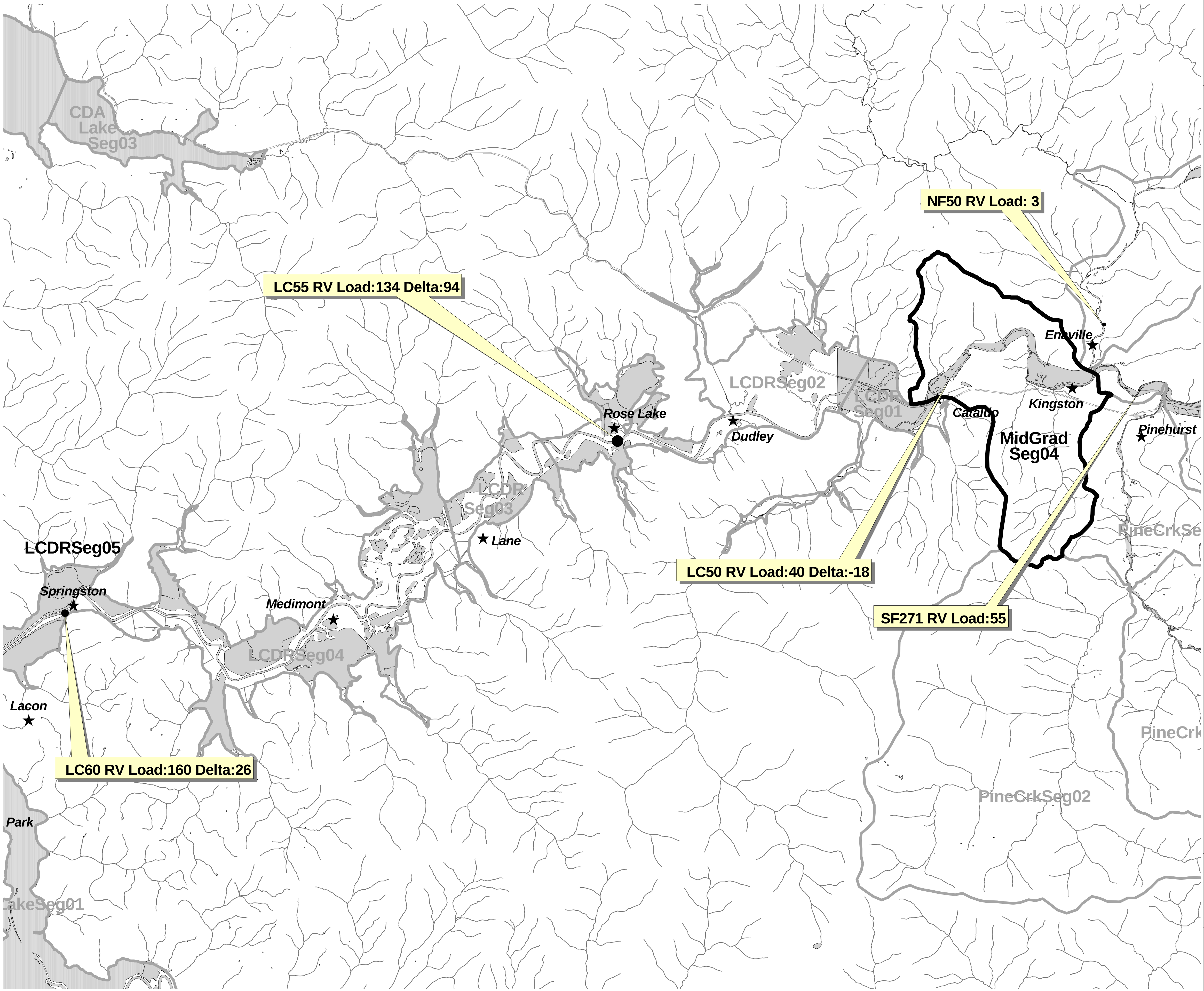
EPA REGION 10

Doc Control 4162500.6615.05.a
Generation 1
n:\Projects\watersheds\Mainstem\
incremental_watershed_mainstem.apr
V: nov97-lead
L: Final RI nov97-lead
7/16/01

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: July 16, 2001

Figure 4.2-2
Main Stem Coeur d' Alene River Watershed
Total Lead Mass Loading
Sampling Results Nov. 1998



LEGEND

Sampling Location

Values are lbs/day

LC 55 RV Load: 134 Delta: 94

Location Type:

RV: River/Stream Sampling Location

(-) Neg.	(+) Pos.	Delta of Mass Load Compared to Preceeding Upstream Sampling Location
		Delta Range: 0 - 0.9
		Delta Range: 1 - 20
		Delta Range: 20 - 40
		Delta Range: 40 - 100
		Delta Range: 100 - 150
		Delta Range: > 150

- Stream
- Interstate 90
- City
- River/Lake
- Main Stem Coeur d'Alene River Watershed
- River Segment
- Source Area

Location Map

NOTES

1) Base map coverages obtained from the Coeur d' Alene Tribe, URS Greiner Inc., CH2M HILL, and the Burueau of Land Management.

SCALE 1: 136,000

0 1 2 3 Miles

N

027-RI-C0-102Q
Coeur d' Alene RI/FS
RI Report

EPA REGION 10

Doc Control 4162500.6615.05.a
Generation 1
n:\Projects\watersheds\Mainstem\incremental_watershed_mainstem.apr
V: nov98-lead
L: Final RI nov98-lead
7/16/01

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: July 16, 2001

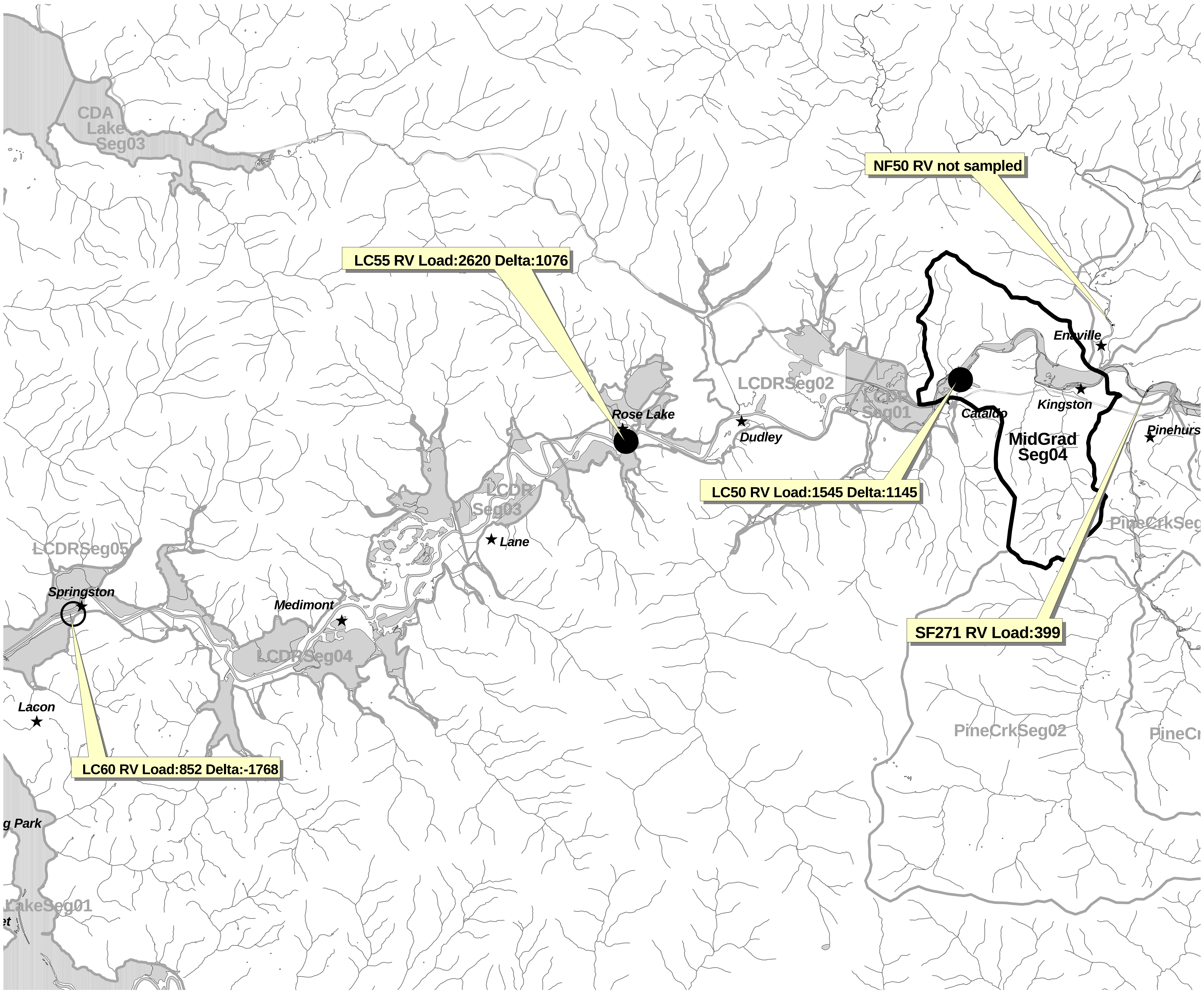


Figure 4.2-3
Main Stem Coeur d' Alene River Watershed
Total Lead Mass Loading
Sampling Results May 1998

LEGEND

Sampling Location — LC50 RV Load: 1545 Delta: 1145 — Values are lbs/day

Location Type:

RV: River/Stream Sampling Location

(-) Neg.	(+) Pos.	Delta of Mass Load Compared to Preceeding Upstream Sampling Location
		Delta Range: 0 - 0.9
		Delta Range: 1 - 20
		Delta Range: 20 - 40
		Delta Range: 40 - 100
		Delta Range: 100 - 150
		Delta Range: > 150

- Stream
- Interstate 90
- City
- River/Lake
- Main Stem Coeur d'Alene River Watershed
- River Segment
- Source Area

Location Map

NOTES

1) Base map coverages obtained from the Coeur d' Alene Tribe, URS Greiner Inc., CH2M HILL, and the Burueau of Land Management.

SCALE 1: 136,000

0 1 2 3 Miles

N

027-RI-C0-102Q
Coeur d' Alene RI/FS
RI Report

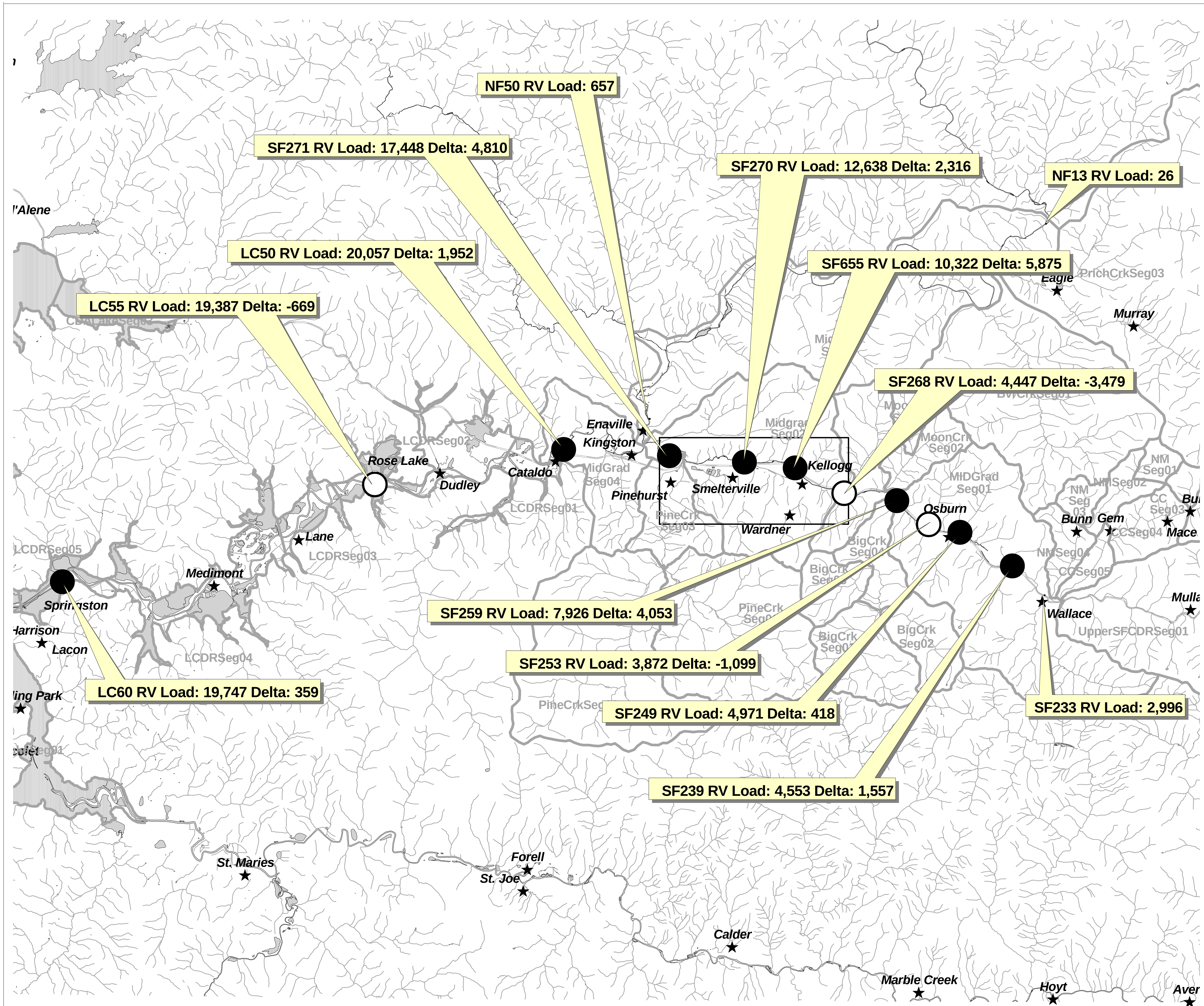
EPA REGION 10

Doc Control 4162500.6615.05.a
Generation 1
n:\Projects\watersheds\mainstem\
incremental_watershed_mainstem.apr
V: may98-lead
L: Final RI may98-lead
7/17/01

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: July 17, 2001

Figure 4.2-4
Main Stem Coeur d' Alene River Watershed
Total Lead Mass Loading
Sampling Results May 1999



LEGEND

Sampling Location

Values are lbs/day

LC60 RV Load: 20014 Delta: 710

Location Type:

RV: River/Stream Sampling Location

(-) Neg. (+) Pos. Delta of Mass Load Compared to Preceeding Upstream Sampling Location

Delta Range: 0 - 100

Delta Range: 100-200

Delta Range: 200-400

Delta Range: 400-800

Delta Range: 800-1600

Delta Range: > 1600

Stream

Interstate 90

City

Bunker Hill Site

River/Lake

Main Stem Coeur d'Alene River Watershed

River Segment

Source Area

Location Map

NOTES

1) Base map coverages obtained from the Coeur d' Alene Tribe, URS Greiner Inc., CH2M HILL, and the Burueau of Land Management.

SCALE 1: 240,000

0 1 2 3 Miles

027-RI-C0-102Q
Coeur d' Alene RI/FS
RI Report

EPA REGION 10

Doc Control 4162500.6615.05.a
Generation 1
n:\Projects\watersheds\mainstem\incremental_watershed_mainstem.apr
V: may99-lead
L: Final RI may99-lead
7/17/01

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: July 17, 2001

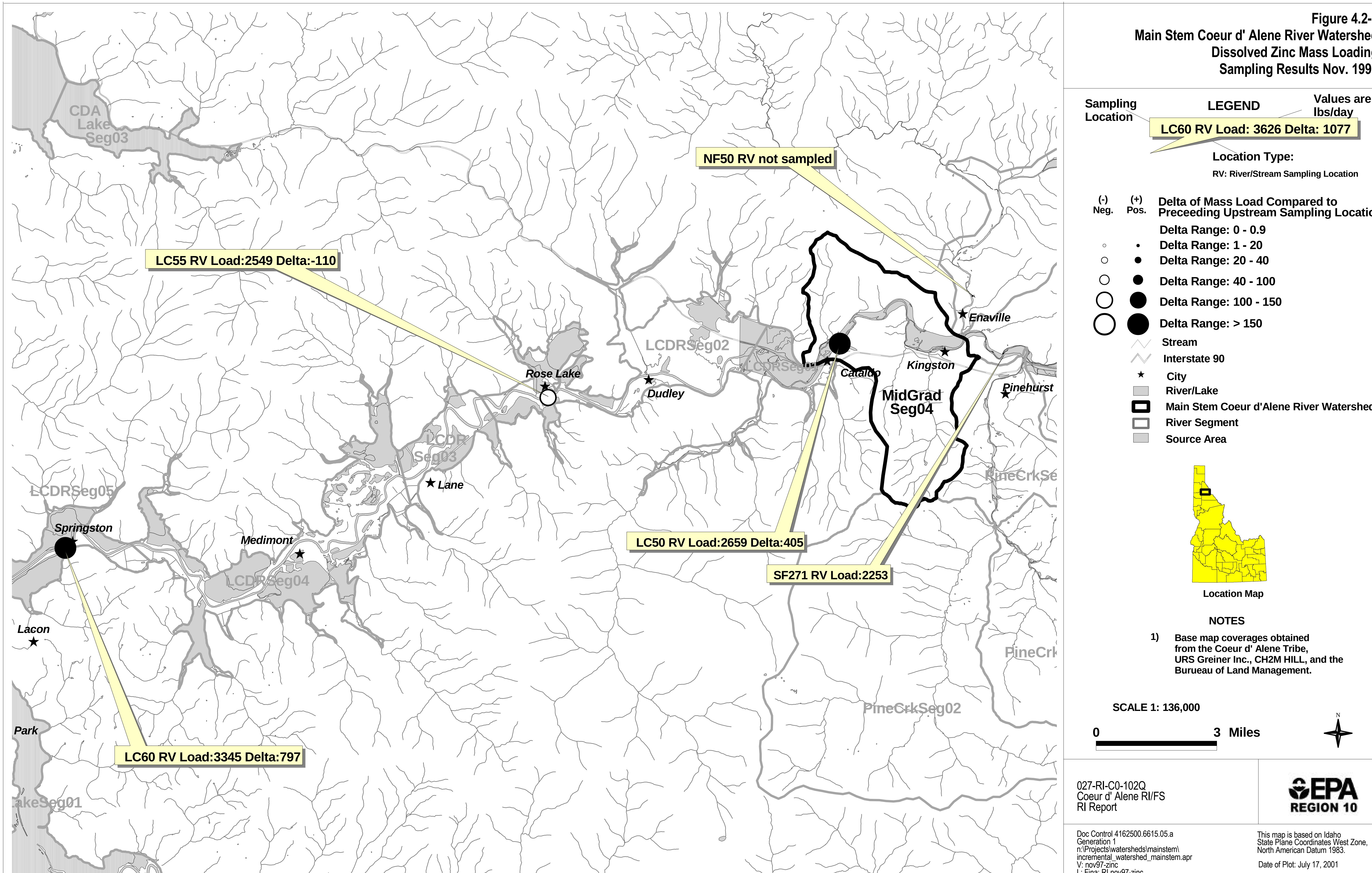


Figure 4.2-5
Main Stem Coeur d' Alene River Watershed
Dissolved Zinc Mass Loading
Sampling Results Nov. 1997

027-RI-C0-102Q
Coeur d' Alene RI/FS
RI Report

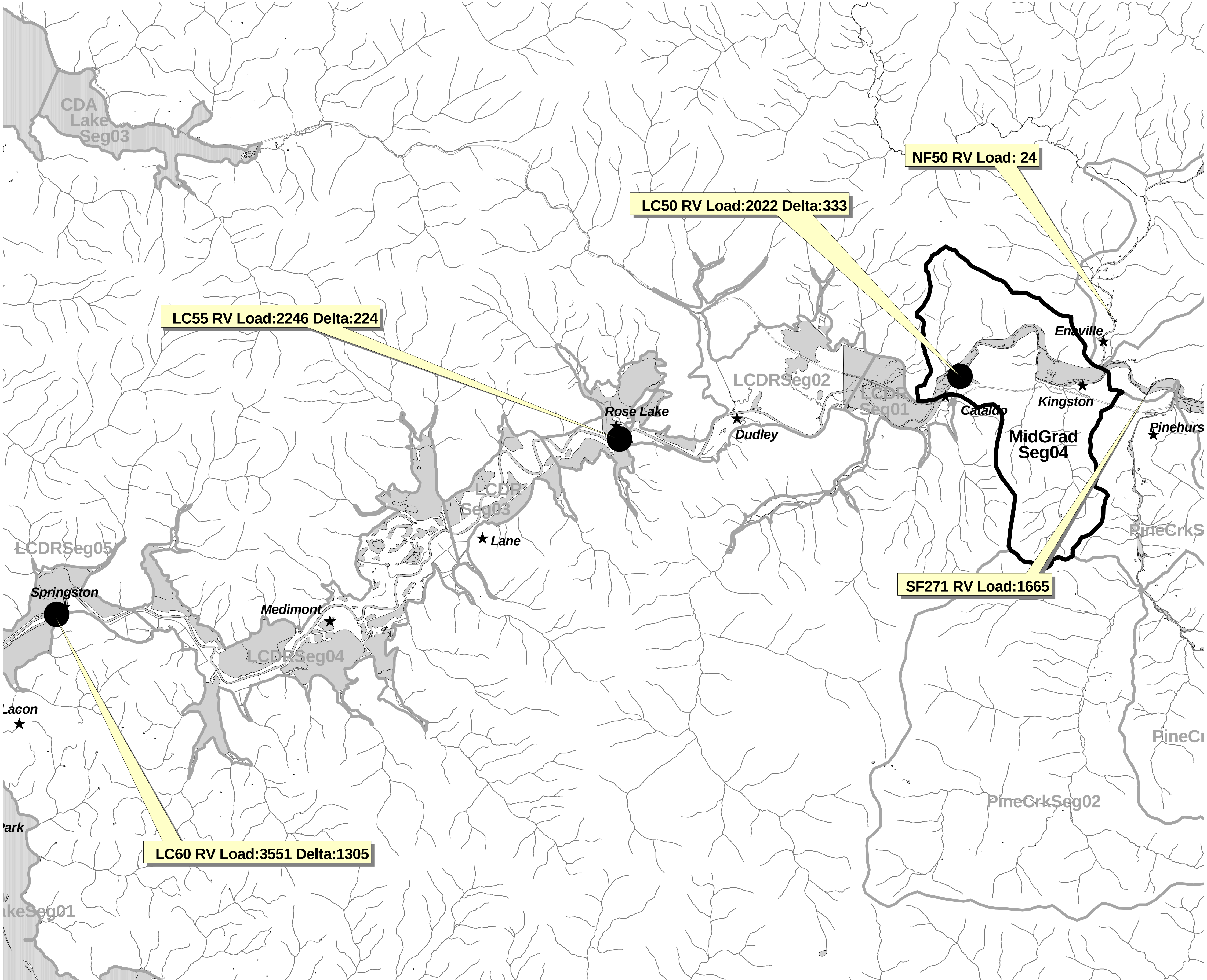
EPA REGION 10

Doc Control 4162500.6615.05.a
Generation 1
n:\Projects\watersheds\mainstem\
incremental_watershed_mainstem.apr
V: nov97-zinc
L: Fina; RI nov97-zinc
7/17/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: July 17, 2001

Figure 4.2-6
Main Stem Coeur d' Alene River Watershed
Dissolved Zinc Mass Loading
Sampling Results Nov. 1998



Sampling Location

LEGEND

Values are lbs/day

SF 368 RV Load: 1133 Delta: 195

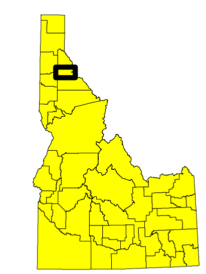
Location Type:

RV: River/Stream Sampling Location

(-) Neg. (+) Pos. Delta of Mass Load Compared to Preceeding Upstream Sampling Location

Delta Range: 0 - 0.9
Delta Range: 1 - 20
Delta Range: 20 - 40
Delta Range: 40 - 100
Delta Range: 100 - 150
Delta Range: > 150

Stream
Interstate 90
City
River/Lake
Main Stem Coeur d'Alene River Watershed
River Segment
Source Area



Location Map

NOTES

1) Base map coverages obtained from the Coeur d' Alene Tribe, URS Greiner Inc., CH2M HILL, and the Bureueau of Land Management.

SCALE 1: 136,000

0 1 2 3 Miles

N

027-RI-C0-102Q
Coeur d' Alene RI/FS
RI Report

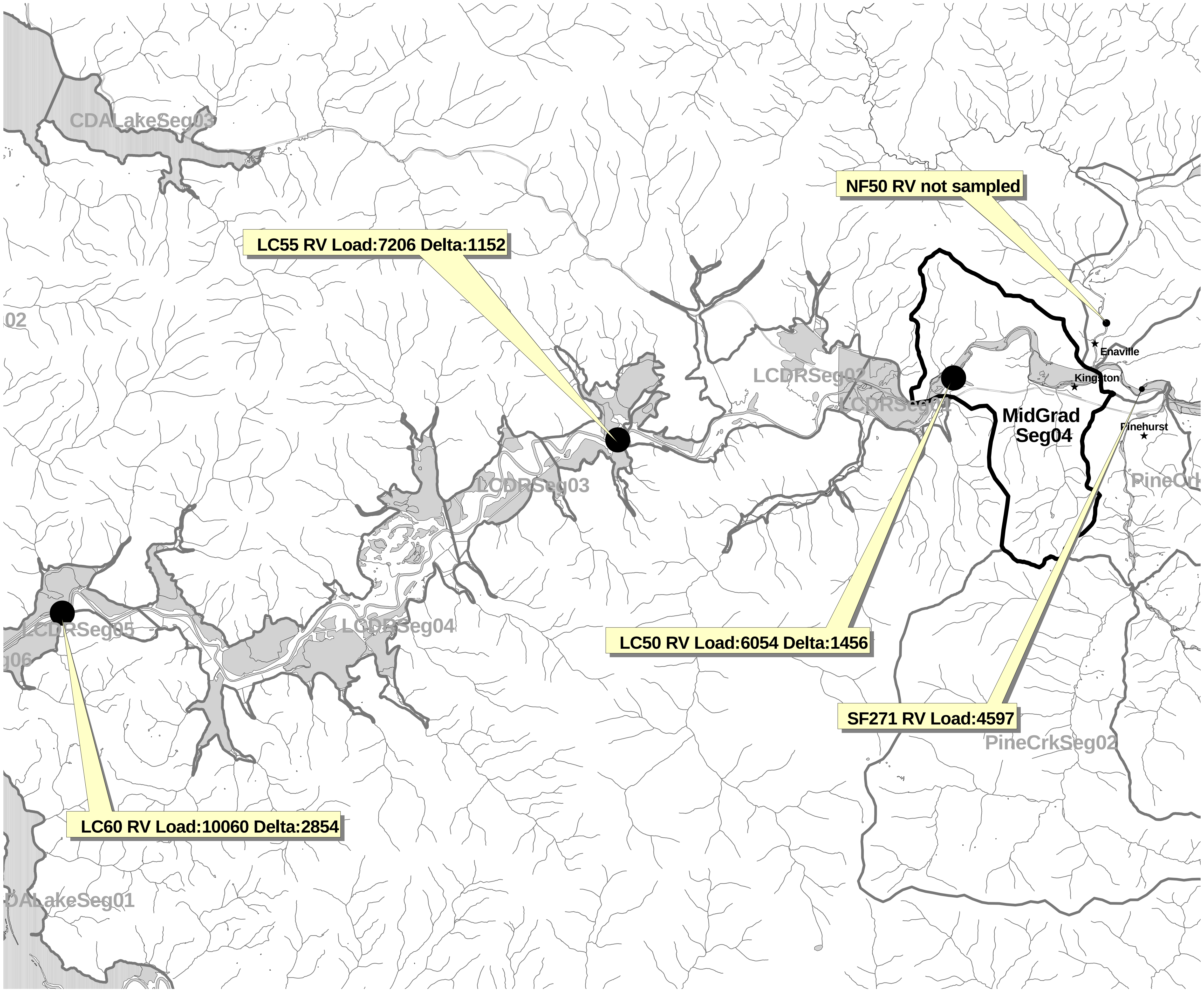
EPA REGION 10

Doc Control 4162500.6615.05.a
Generation 1
n:\Projects\watersheds\Mainstem\incremental_watershed_mainstem.apr
V: nov98-zinc
L: Final RI SF-nov98-zinc
7/17/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: July 17, 2001

Figure 4.2-7
Main Stem Coeur d' Alene River Watershed
Dissolved Zinc Mass Loading
Sampling Results May 1998



LEGEND

Sampling Location

Values are lbs/day

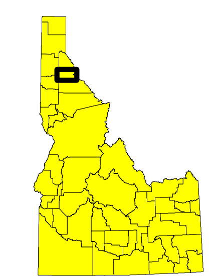
LC55 RV Load: 7206 Delta: 1152

Location Type:

RV: River/Stream Sampling Location

(-) Neg.	(+) Pos.	Delta of Mass Load Compared to Preceeding Upstream Sampling Location
		Delta Range: 0 - 0.9
		Delta Range: 1 - 20
		Delta Range: 20 - 40
		Delta Range: 40 - 100
		Delta Range: 100 - 150
		Delta Range: > 150

Stream
Interstate 90
City
River/Lake
Main Stem Coeur d'Alene River Watershed
River Segment
Source Area



Location Map

NOTES

1) Base map coverages obtained from the Coeur d' Alene Tribe, URS Greiner Inc., CH2M HILL, and the Burueau of Land Management.

SCALE 1: 136,000

0 1 2 3 Miles

N

027-RI-C0-102Q
Coeur d' Alene RI/FS
RI Report

EPA REGION 10

Doc Control 4162500.6615.05.a
Generation 1
n:\Projects\watersheds\Mainstem\incremental_watershed_mainstem.apr
V: may98-zinc
L: Final RI may98-zinc
7/17/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: July 17, 2001

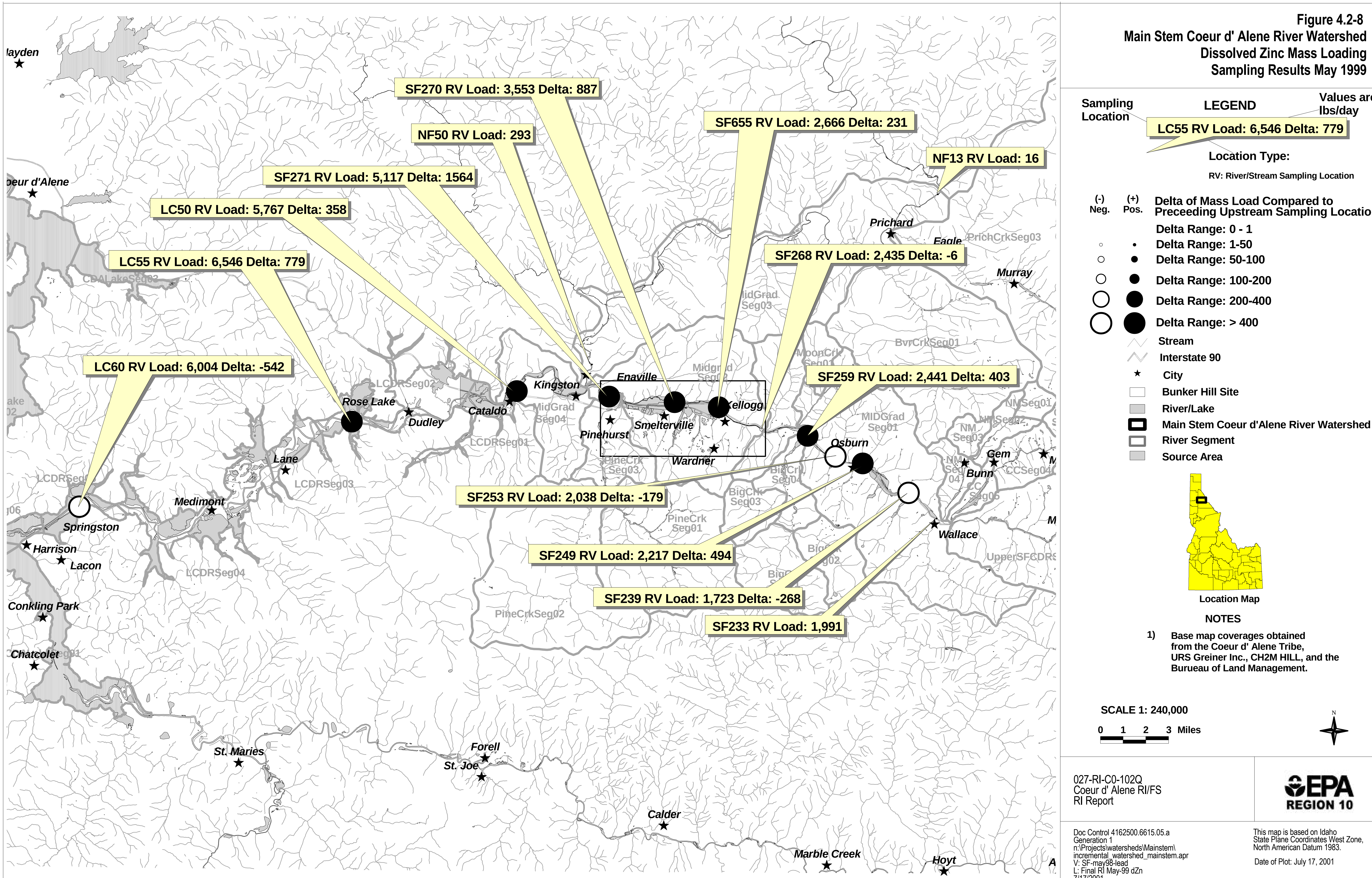


Figure 4.2-8
Main Stem Coeur d' Alene River Watershed
Dissolved Zinc Mass Loading
Sampling Results May 1999

Table 4.1-1
Potential Source Areas Within Main Stem Coeur d'Alene - segment MidGradSeg04

Source Area Name	Source ID	Area (Acres)	Source Description	No. Samples By Matrix Type	Metals > 1X	Metals > 10X	Metals > 100X
HYPOTHEEK MINE	CAT008	3.22	Mine Workings/Water, Seeps, Springs and Leachate				
HYPOTHEEK MINE	CH1449	3.22	Upland waste rock				
LINFOR COPPER	CAT001	0.28	Upland waste rock				
MCGREGOR MINE	CH1448	0.39	Upland waste rock				
MISSION GROUP	CAT002	0.36	Upland waste rock				

Matrix Types

DR: Debris/Rubble
GW: Groundwater
RK: Rock/Cobbles/Gravel
SB: Subsurface Soil
SD: Sediment
SL: Soil
SS: Surface Soil
SW: Surface Water

Matrix Groupings

GWD: Groundwater - Dissolved Metals
GWT: Groundwater - Total Metals
SBT: Subsurface Soil
SDT: Sediment
SST: Surface Soil
SWD: Surface Water - Dissolved Metals
SWT: Surface Water - Total Metals

Analytes

Ag: Silver
As: Arsenic
Cd: Cadmium
Cu: Copper
Fe: Iron
Hg: Mercury
Mn: Manganese
Pb: Lead
Sb: Antimony
Zn: Zinc

Table 4.2-1
Mass Loading Main Stem

Location	Segment	Sample Type	Sample No.	Sample Date	Flow CFS	Flow Delta	Total Lead			Dissolved Zinc		
							Conc. µg/l	Load lbs/day	Delta[a] lbs/day	Conc. µg/l	Load lbs/day	Delta[a] lbs/day
NF50[b]	2	RV	-	Not sampled	-	-	-	-	-	-	-	-
SF271*	2	RV	186259	25-Nov-97	349	-	611	1,147	-	1,200	2,253	-
LC50	2	RV	186246	24-Nov-97	1,420	-	11	84	-1,063	348	2,659	405
LC55	3	RV	186258	24-Nov-97	1,410	-10	9	68	-16	336	2,549	-110
LC60	3	RV	186252	24-Nov-97	1,410	-	18	137	68	441	3,345	797
NF50	2	RV	-	Not sampled	-	-	-	-	-	-	-	-
SF271	2	RV	202250	29-May-98	1,350	-	55	399	-	633	4,597	-
LC50	2	RV	202232	28-May-98	7,760	-	37	1,545	1,145	145	6,054	1,456
LC55	3	RV	202243	28-May-98	7,610	-150	64	2,620	1,076	176	7,206	1,152
LC60	3	RV	202239	28-May-98	7,540	-70	21	852	-1,768	234	9,492	2,287
NF50	2	RV	186824	17-Nov-98	595	-	1	3	-	8	24	-
SF271	2	RV	186996	17-Nov-98	162	-	63	55	-	1,910	1,665	-
LC50	2	RV	187012	18-Nov-98	819	62	9	40	-18	459	2,022	333
LC55	3	RV	187127	16-Nov-98	994	175	25	134	94	420	2,246	224
LC60	3	RV	187035	16-Nov-98	1,100	106	27	160	26	600	3,551	1,305
USGS 1999 Synoptic Sampling Event**												
SF233	2	RV	186909	24-May-99	1,160	-	480	2,996	-	319	1,991	-
SF239	2	RV	186928	26-May-99	1,570	410	539	4,553	1,557	204	1,723	-268
SF249	2	RV	186937	26-May-99	1,848	278	500	4,971	418	223	2,217	494
SF253	2	RV	186942	24-May-99	1,509	-339	477	3,872	-1,099	251	2,038	-179
SF259	2	RV	186943	24-May-99	1,725	216	854	7,926	4,053	263	2,441	403
SF268	2	RV	186965	25-May-99	2,460	735	336	4,447	-3,479	184	2,435	-6
SF655	2	RV	186968	25-May-99	2,650	190	724	10,322	5,875	187	2,666	231
SF270	2	RV	186979	25-May-99	2,610	-40	900	12,638	2,316	253	3,553	887
SF271	2	RV	187007	25-May-99	4,190	1,580	774	17,448	4,810	227	5,117	1,565

Table 4.2-1 (Continued)
Mass Loading Main Stem

Location	Segment	Sample Type	Sample No.	Sample Date	Flow CFS	Flow Delta	Total Lead			Dissolved Zinc		
							Conc. mg/l	Load lbs/day	Delta[a] lbs/day	Conc. mg/l	Load lbs/day	Delta[a] lbs/day
NF13	2	RV	186809	24-May-99	4,750	-	1	26	-	1	16	-
NF50	2	RV	186832	25-May-99	11,100	-	11	657	-	5	293	-
LC50	2	RV	187022	25-May-99	16,000	710	233	20,057	1,952	67	5,767	358
LC55	3	RV	187032	26-May-99	15,600	-400	231	19,387	-669	78	6,546	779
LC60	3	RV	187040	27-May-99	12,400	-3,200	296	19,747	359	90	6,004	-542

[a]The Delta value reported at a sample location is the difference between mass load at that location and the next upstream sample location. For LC50, the Delta value is the difference between the mass load at LC50 and the sum of the mass loads at SF271 and NF50, except as noted.

[b]NF50 not sampled. Mass load delta at LC50 estimated assuming mass load at NF50 is negligible. Mass load at NF50 typically ranges from 2 to 6% of the load at LC60 for dissolved zinc and from 1 to 7% of the load at LC60 for total lead.

Notes: The May 1999 sampling was conducted by USGS.
- : No Data or Delta Not Calculated
* : Total lead concentration appears biased high relative to historic flows verses concentrations
**: Upstream sampling results included for comparison
RV: River Sample
CFS: Cubic Feet per Second
μg/l: Micrograms per liter
lbs/day: pounds per day

5.0 FATE AND TRANSPORT

The fate and transport of metals in surface water, groundwater, and sediment in the Main Stem Watershed are discussed in this section. A conceptual model of fate and transport, important fate and transport mechanisms, and a summary of the probabilistic model developed to evaluate fate and transport, were presented in the fate and transport section in the Canyon Creek report and are not repeated here. This section draws upon that general information.

Initial findings on metals concentrations and mass loading for each segment, as presented above in Section 4, Nature and Extent, are briefly summarized in Section 5.1. Results of the probabilistic modeling are presented in Section 5.2. Sediment transport is summarized in Section 5.3. A summary of fate and transport of metals in the main stem is presented in Section 5.4.

5.1 INTRODUCTION

As a result of mining related activities, the main stem contains significant quantities of cadmium, lead, zinc, and other metals. The lowest and highest dissolved cadmium and zinc and total lead loadings measured during six sampling events (May, 1991; October, 1991; November, 1997; May, 1998; November, 1998, and May, 1999) are listed in Table 5.1-1. Potential sources of these metals in the watershed were identified in Section 4.1 and preliminary mass loading estimates were discussed in Section 4.2. Brief summaries of those results are included in this section.

The main stem is transitional in that it is somewhat wider and flatter (with broader meanders) than the upper reaches of the Coeur d'Alene River, yet not as wide or flat as the Lower Coeur d'Alene River Watershed and Lateral Lakes region. Surface water and sediment derived in the North and South Forks are transported through the segment to the Lateral Lakes region. The BLM identified five source areas in this segment. Sampling of surface water indicates that metals concentrations are greater than AWQC. Concentrations of metals in sediment samples collected from this segment exceed screening levels for all ten metals of potential concern.

5.2 MODEL RESULTS

Results from the probabilistic model are discussed for cadmium, lead, and zinc in this section. Modeling results for estimates of discharge are discussed in Section 5.2.1. Modeling results for estimates of chemical concentrations and mass loading of cadmium, lead, and zinc are discussed in Section 5.2.2. Model results are summarized in Table 5.2-1. Modeling results are included in Appendix C.

Data were evaluated for two separate sampling locations. Only sampling locations with 10 or more individual data points for each parameter of interest were evaluated. In the main stem, the two sampling locations evaluated, in order from upstream to downstream are SF271 and LC50. The two sampling locations are shown on Figure 5.2-1. The first and most upgradient sampling location evaluated, SF271, is situated prior to the confluence of the North Fork and South Fork Coeur d'Alene Rivers. The second sampling location (LC50) is near the town of Cataldo.

The river stretch bracketed by the sampling locations is designated a reach. The one reach evaluated is between sampling locations SF271 and LC50.

5.2.1 Estimated Discharge

An example of the lognormal distribution of discharge data at sampling location LC50 is shown in Figure 5.2-2. Data from this sampling location are used throughout this discussion for consistency of presentation and, additionally, because it is the station evaluated that is farthest downstream on the Main Stem. Figures for sampling location SF271 are presented the South Fork Remedial Investigation report.

In Figure 5.2-2, the discharge in cubic feet per second (cfs) is plotted on a log scale versus the normal standard variate. The normal standard variate is equivalent to the standard deviation for a normalized variable. When the log of a parameter (e.g., discharge) is plotted versus the standard normal variate, a straight line will result if the data are lognormally distributed. The cumulative distribution function gives the probability that the observed discharge at any given time will not be exceeded by the estimated discharge at that cumulative probability. The cumulative distribution function is plotted versus the normal standard variate in Figure 5.2-3. To determine the probability of occurrence of a specific discharge, first select the discharge of interest on Figure 5.2-2, then find its corresponding normal standard variate. Using that value for the normal standard variate, look up its corresponding probability in Figure 5.2-3. For example, for a discharge of 1,000 cfs, the normal standard variate is approximately -0.5 (Figure 5.2-2).

Looking on Figure 5.2-3, this value corresponds to a probability of 0.31; therefore, 31 percent of the time, discharges at this location will be 1,000 cfs or less.

As shown in Figure 5.2-2, there is a good fit of the lognormal regression line (solid line in Figure 5.2-2) to the data. This goodness of fit, as evidenced by a high coefficient of determination (r^2 = 0.96), supports the assumption that discharges are lognormally distributed. The dotted line represents the true (ideal) lognormal distribution having the same mean (2,700) and coefficient of variation (1.29) as the actual data. The expected value, or average discharge rate for the main stem at sampling location LC50 is approximately 2,740 cfs. Expected values for discharge at both sampling locations are summarized in Table 5.2-1.

The probability distribution function (PDF) shown in Figure 5.2-2 is a predictive tool that can be used to estimate the expected discharge and provide a quantitative estimate of the probability that the observed discharge will not exceed a given value. Conversely, one can find the estimated discharge rate having a specified probability of exceedence or non-exceedence by the observed discharge.

Estimated gains or losses in discharge (EV) and the coefficients of variation (CV) for the reach on the main stem are listed in Table 5.2-2. The reach between SF271 and LC50 gains an estimated 2,207 cfs. As indicated, there is a large increase in the estimated discharge within this reach. The majority of this increase can be explained by the flow of the North Fork into the South Fork at Enaville. The estimated expected value for discharge at sampling location NF50 (shown on Figure 5.2-1) is approximately 1,660 cfs.

5.2.2 Estimated Zinc, Lead, and Cadmium Concentrations and Mass Loading

Dissolved cadmium, zinc, and total lead concentrations and loads were evaluated using the probabilistic model at the two sampling locations (one reach) that contained a minimum of ten data points.

5.2.2.1 Individual Sampling Locations

To illustrate the lognormal distribution of dissolved zinc, total lead, and dissolved cadmium concentrations and dissolved zinc, total lead, and dissolved cadmium loading at sampling location LC50 on the Main Stem, Figures 5.2-4 to 5.2-9 are provided. The high r-squared values (r^2) for the concentrations and loads when plotted lognormally attest to the fact that the data follow a lognormal distribution. For dissolved concentrations, the r-squared values for zinc and cadmium were 0.94 and 0.62, respectively. The r-squared value for the total lead concentration was 0.76. The corresponding values for dissolved zinc, total lead, and dissolved cadmium loads were 0.94, 0.87, and 0.93, respectively.

To assist in interpreting and placing the results in context, screening levels and expected values (EV), are shown on the figures where applicable.

The screening level for dissolved cadmium in surface waters is 0.38 µg/l. The majority of the measured dissolved cadmium concentrations at LC50 were greater than this screening level. The estimated dissolved cadmium concentration of approximately 3.19 µg/l exceeds the screening level (Figure 5.2-4).

Measured and plotted total lead concentrations most often are less than, but sometimes exceed, the screening level for total lead in surface waters (15 µg/l, Figure 5.2-5). The estimated expected lead concentration (approximately 21 µg/l) exceeds the screening level.

All dissolved zinc concentrations plotted on Figure 5.2-6 are greater than the screening level (42 µg/l) for dissolved zinc concentrations in surface waters. The estimated dissolved zinc concentration (approximately 354 µg/l) exceeds the screening level by almost an order of magnitude.

The estimated dissolved cadmium load at LC50 is approximately 26.9 pounds/day (Figure 5.2-7). The estimated expected value for dissolved cadmium loads is greater than the 90th percentile TMDL (13.7 pounds/day) at Harrison.

The estimated total lead load at LC50 is approximately 708 pounds/day (Figure 5.2-8). The estimated expected value is greater than the 90th percentile TMDL (20 pounds/day) at Harrison.

As seen on Figure 5.2-9, all measured and plotted values of dissolved zinc loading at LC50, with one exception, exceeded the 50th percentile TMDL (261 pounds/day) for the dissolved zinc load at Harrison. The estimated value of 3,220 pounds/day is greater than the 90th percentile TMDL (1,200 pounds/day) for the dissolved zinc load at Harrison.

Figures similar to Figures 5.2-4 to 5.2-9 were developed for both sampling locations. The results of these and additional analyses are presented in Appendix C. Data in Appendix C were used to compute gains or losses in expected values and the coefficients of variation for dissolved cadmium, zinc, and total lead concentrations and loads in the one reach of the Main Stem. Results are presented in Tables 5.2-3 to 5.2-5. The calculations were performed in the same manner as described in the section on discharge (Section 5.2.1).

In every instance, estimated dissolved and total concentrations decreased and dissolved and total loads increased. These results reflect the addition of surface water from the North Fork to the South Fork in this reach. Lower dissolved and total concentrations of metals are encountered in the North Fork than in the South Fork; therefore, when the North Fork enters the South Fork, the dissolved and total metal concentrations decrease. However, because of the discharge of the North Fork into the South Fork, this reach gains, approximately 2,200 cfs. This increased discharge, even though the concentrations are lower, increases the total loading of the main stem at LC50.

5.2.2.2 Watershed Description

There are no significant primary sources of mining wastes in this segment; however, there are numerous deposits of alluvium contaminated by mining wastes. Some loading occurs in this segment because of exchanges of surface water and groundwater, but loading from groundwater is considerably less than in segments MidGradSeg01 and MidGradSeg02. Alluvial deposits containing mining wastes are mobilized during high flows and transported downstream as bedload and suspended load.

Because of the relatively large (approximately 2,200 cfs) increase in discharge that comes primarily from the North Fork with its lower concentrations, dissolved and total concentrations of zinc, lead, and cadmium decreased. Again, because of the large increase in discharge, the dissolved and total loads of zinc, lead, and cadmium increase. For reference, estimated expected values for discharge and metals concentrations and loading for sampling location NF50, located in the North Fork just upgradient from its confluence with the South Fork, are included in Table 5.2-1.

Estimated expected values of dissolved zinc (approximately 354 µg/l) and total lead (approximately 21 µg/l) concentrations exceed their screening levels at LC50. Estimated concentrations of dissolved zinc exceed screening levels by almost an order of magnitude. The 90th percentile TMDLs established for the Lower CDR at Harrison are 1,200 pounds/day for zinc, 20.0 pounds/day for lead, and 13.7 pounds/day cadmium. These 90th percentile values were exceeded at LC50 by the dissolved zinc load (approximately 3,200 pounds/day), total lead load (approximately 710 pounds/day), and by the dissolved cadmium load (approximately 27 pounds/day) loads.

Based on results from the probabilistic model, it is anticipated that approximately 80 percent of the zinc load, 15 percent of the lead load, and 85 percent of the cadmium load are in the dissolved phase. Based on evaluation of SF271 and LC50 through probabilistic modeling, this segment contributes approximately 300 pounds/day of zinc, 340 pounds/day of lead, and 6 pounds/day of cadmium to the river system. A large portion of the total load is contributed by the South Fork with additional contributions from the alluvial deposits containing mining wastes.

5.2.2.3 Concentrations Versus Discharge

The following discussion is based on evaluation of data at LC50 (Appendix C). There is a decrease in dissolved zinc concentrations with increased discharge which is significant at $a < 0.0001$ (a is the probability the correlation is due to chance). As one would expect, given that the majority of the zinc is in the dissolved phase, there is also a decrease in total zinc concentrations with increased discharge rates ($a < 0.0001$). Total lead concentrations increased with increasing discharge ($a < 0.0001$). Similarly to zinc, estimated values of dissolved ($a < 0.0001$) cadmium concentrations also exhibited decreased concentrations with increased discharge at sampling location LC50.

The regressions permit estimation of dissolved zinc, lead, and cadmium concentrations at various discharge rates. Similar regressions were developed at the other sampling location. At SF271, there was a decrease in dissolved and total zinc and cadmium concentrations with increasing discharge rates (Appendix C). In opposition to zinc and cadmium, estimated total lead concentrations increased with increasing discharge.

5.3 SEDIMENT FATE AND TRANSPORT

Sediment fate and transport processes were presented in Section 3.0. Results of the sediment transport evaluation presented in Section 3.0 are summarized in this section.

Sediment derived in the North and South Forks is transported to the upstream end of segment MidGradSeg04. Within segment MidGradSeg04, some sediment may be deposited; however, based on review of aerial photographs, much if not all of this sediment is transported through the segment to lateral lakes area. Sediment sources in this segment are sediment derived from the North and South Forks, mining wastes, channel bed sediment, bank erosion, and lateral migration of the channel.

Sediment transport data are not available for areas within segment MidGradSeg04. However, sediment transport information is available from the Coeur d'Alene River at Rose Lake, approximately 7.7 miles downstream of segment MidGradSeg04. Estimates of the magnitude of suspended sediment transport at the Rose Lake gage based on transport data collected by USGS indicate approximately 6,690 tons of sand, and 23,266 tons of fines were transported during water year 1999. Similar magnitudes would be expected in segment MidGradSeg04. Bedload transport data were not collected at the Rose Lake gage.

Suspended sediment and bedload samples were not analyzed for total metals; therefore mass loading was estimated from total and dissolved surface water data as described in Section 5.2.

5.3.1 Watershed Description

The Main Stem Watershed has approximately 30,000 feet, or 5.7 miles, of channel. Channel slope is relatively flat, ranging from 0.12 to 0.16 percent. The channel alignment is generally in one channel that ranges from 100 to 300 feet wide, and is constrained by roadway embankments (I-90), railroad embankments, bridge structures and hillslopes. At Kingston, however, the river is heavily braided with multi-threaded channels. The multiple channels span the width of the valley, 1,000 to 2,000 feet. Numerous relict channels and ponds cover much of the valley bottom. Likely sediment sources in the Main Stem Watershed are lateral migration, channel bed remobilization, and minor bank erosion.

5.3.2 Summary of Sediment Transport

Estimates of the magnitude of suspended sediment transport at the Rose Lake gage based on transport data collected by USGS indicate approximately 6,690 tons of sand, and 23,266 tons of fines were transported during water year 1999. Similar magnitudes would be expected in segment MidGradSeg04. Sediment sources include channel bed remobilization, minor bank erosion, lateral migration and rock debris piles adjacent to the stream. Though suspended and bedload sediment samples were not collected and analyzed for metals, suspended and bedload sediment concentrations may be represented by metals concentrations reported for sediment samples collected in the main stem. As presented in Section 4.1, Nature and Extent, metals concentrations in sediment samples exceeded screening levels for all ten metals of potential concern.

5.4 SUMMARY OF FATE AND TRANSPORT

The probabilistic model was used to quantify and summarize the available data and to estimate pre-remediation metals concentrations in surface water and mass loading to the main stem. Sediment transport was evaluated using USGS suspended and bedload sediment discharge data and measured sediment data. Results are summarized in this section.

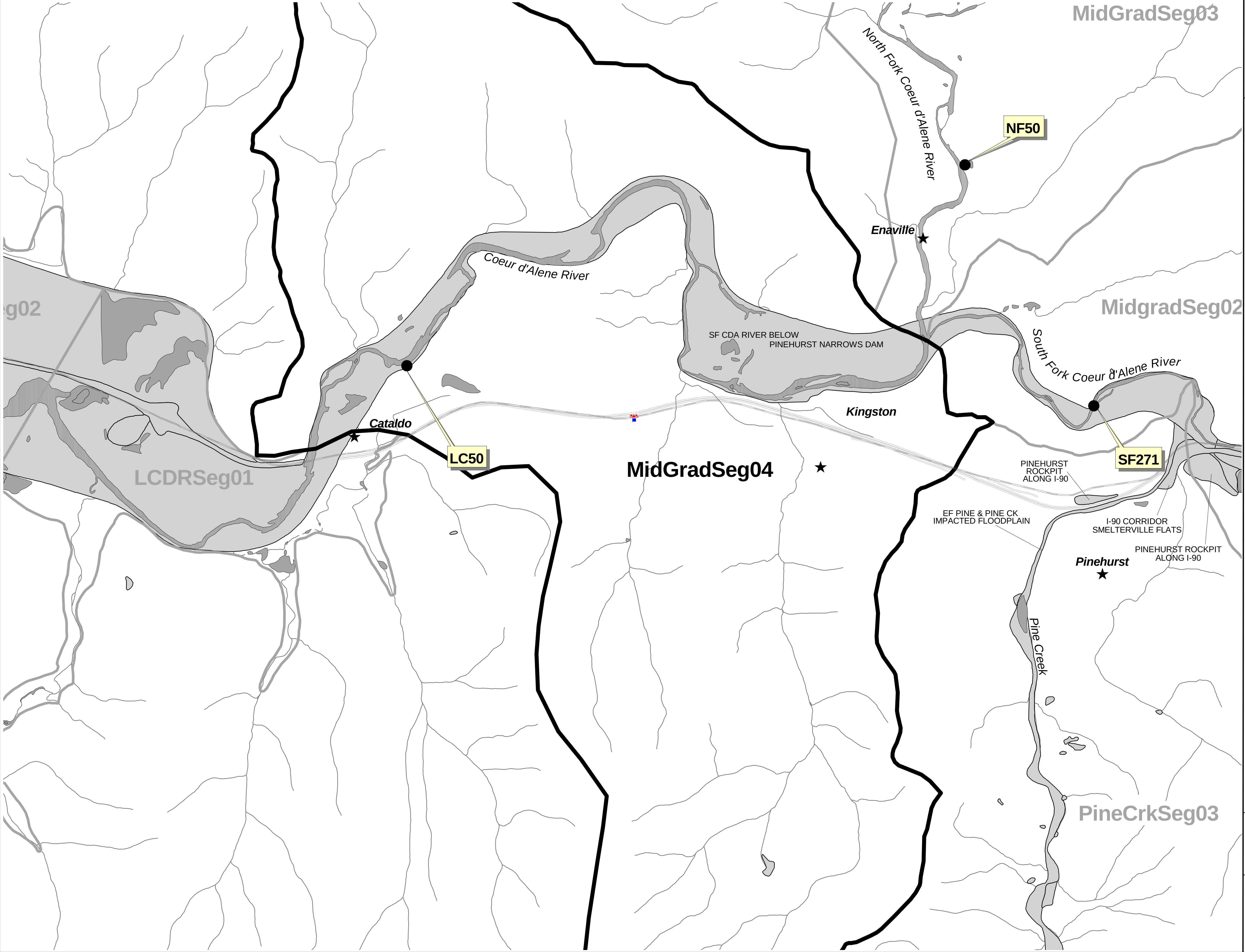
Surface water discharge, metals concentrations (total and dissolved), and mass loading data were analyzed using lognormal probability density functions (PDFs) at two separate sampling locations in the main stem. Only results for cadmium, lead, and zinc were analyzed. Regressions were developed for total and dissolved concentrations versus discharge to quantify and identify trends in concentrations and mass loading with changing discharge rates. The percentages of dissolved and particulate forms of metals were computed from the estimated expected values predicted by the model.

Results of the probabilistic modeling indicate:

- Dissolved cadmium and zinc concentrations and total lead concentrations exceed their corresponding screening levels at both sampling locations. Estimated dissolved zinc concentrations exceed screening levels by almost an order of magnitude.
- Dissolved zinc and cadmium loads and total lead loads exceed TMDLs established for the Coeur d'Alene River at Harrison.
- Even though a decrease in metals concentrations was observed due to the increase in discharge contributed by the North Fork, metals concentrations continue to exceed screening levels.
- Dissolved zinc and cadmium concentrations decrease with increased discharge which is significant at a < 0.0001 (α is the probability the correlation is due to chance).
- Total lead concentrations increase with increasing discharge.
- Potential major source areas identified in this segment include the South Fork Coeur d'Alene River and the main stem floodplain sediments.

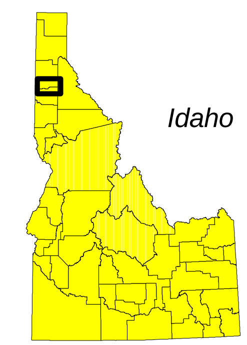
To illustrate the observed trends of estimated expected values throughout the watershed, estimated expected values for cadmium, lead, and zinc concentrations and mass loading are shown in Figures 5.4-1 through 5.4-6.

Figure 5.2-1
Main Stem Coeur d'Alene River Watershed Sampling Locations Evaluated in Probabilistic Modeling



LEGEND

- Sampling Location
- Stream
- Interstate 90
- Road
- City
- Main Stem Coeur d'Alene River Watershed
- River Segment
- Lake/River
- Source Area



Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL, and the Bureau of Land Management.

N

SCALE 1: 36,000

0 0.5 Miles

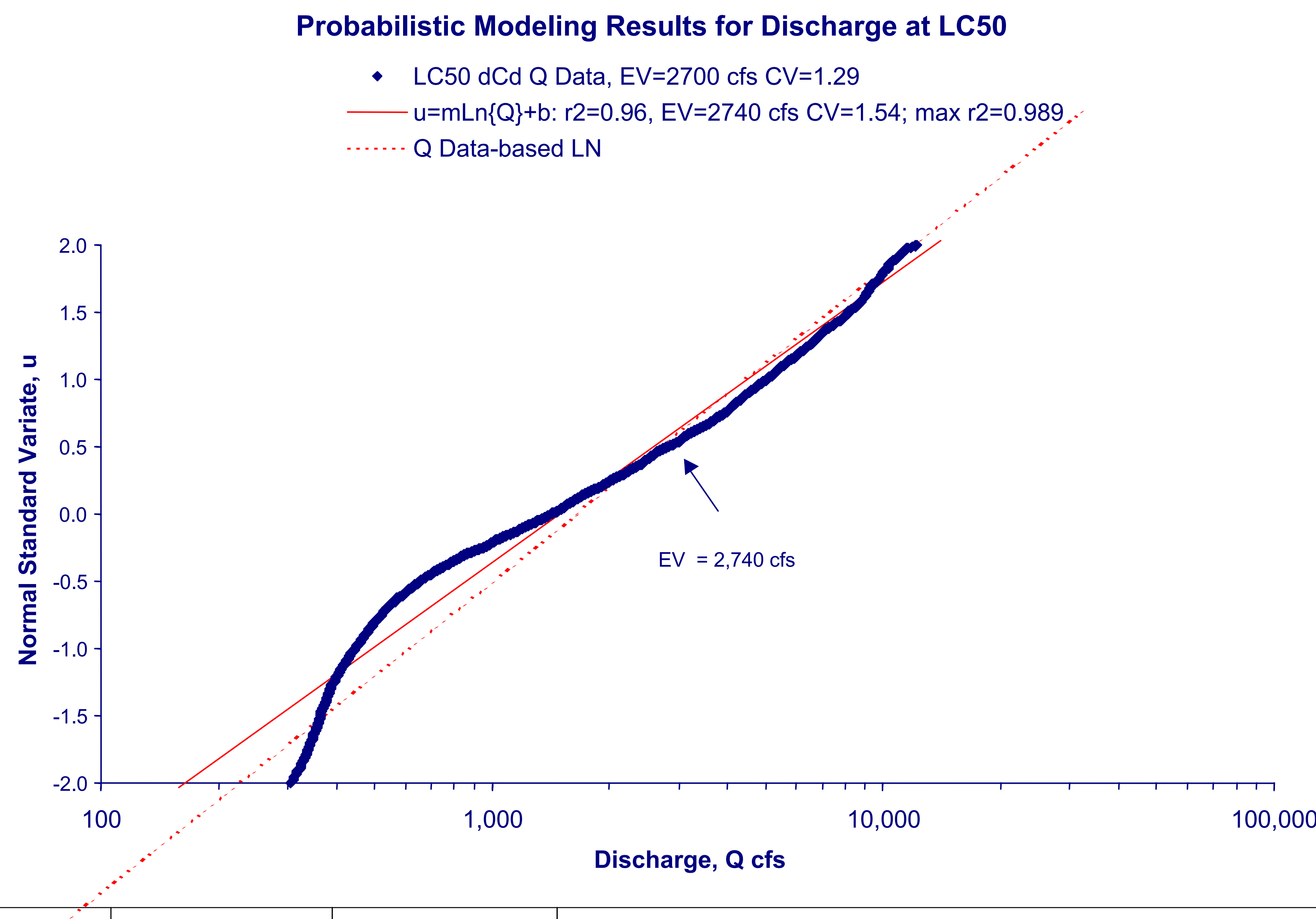
027-RI-C0-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

EPA REGION 10

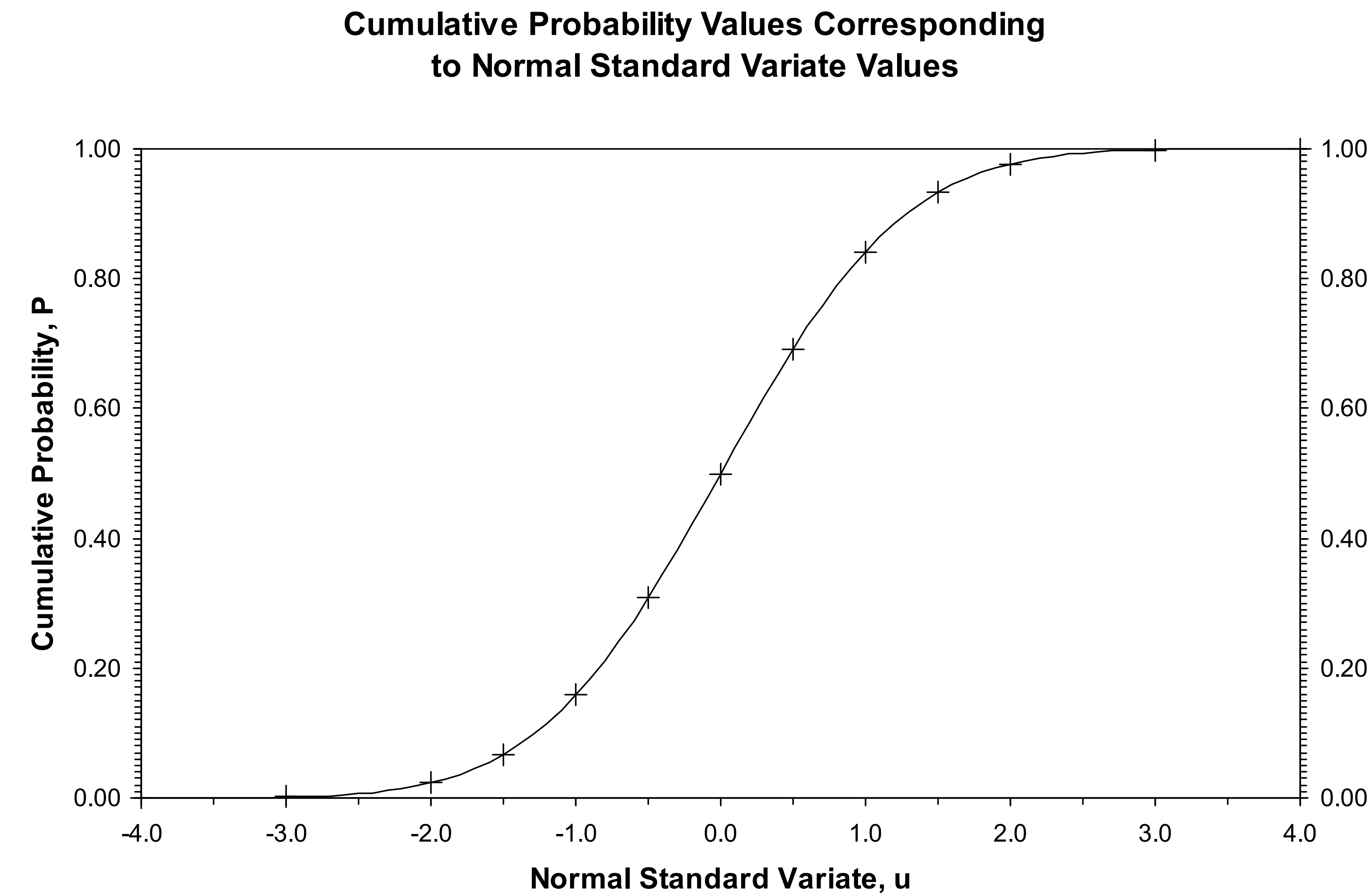
Doc Control 4162500.6615.05.a
Generation 1
n:\Projects\watersheds\Mainstem\
|mainstem_ev7-26.apr
V:Locate
E:Locate
L: Final RI Locate
7/17/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: July 17, 2001



EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc Control: 4162500.6615.05.a Generation: 1 Main Stem Series 07/13/01	**Figure 5.2-2**



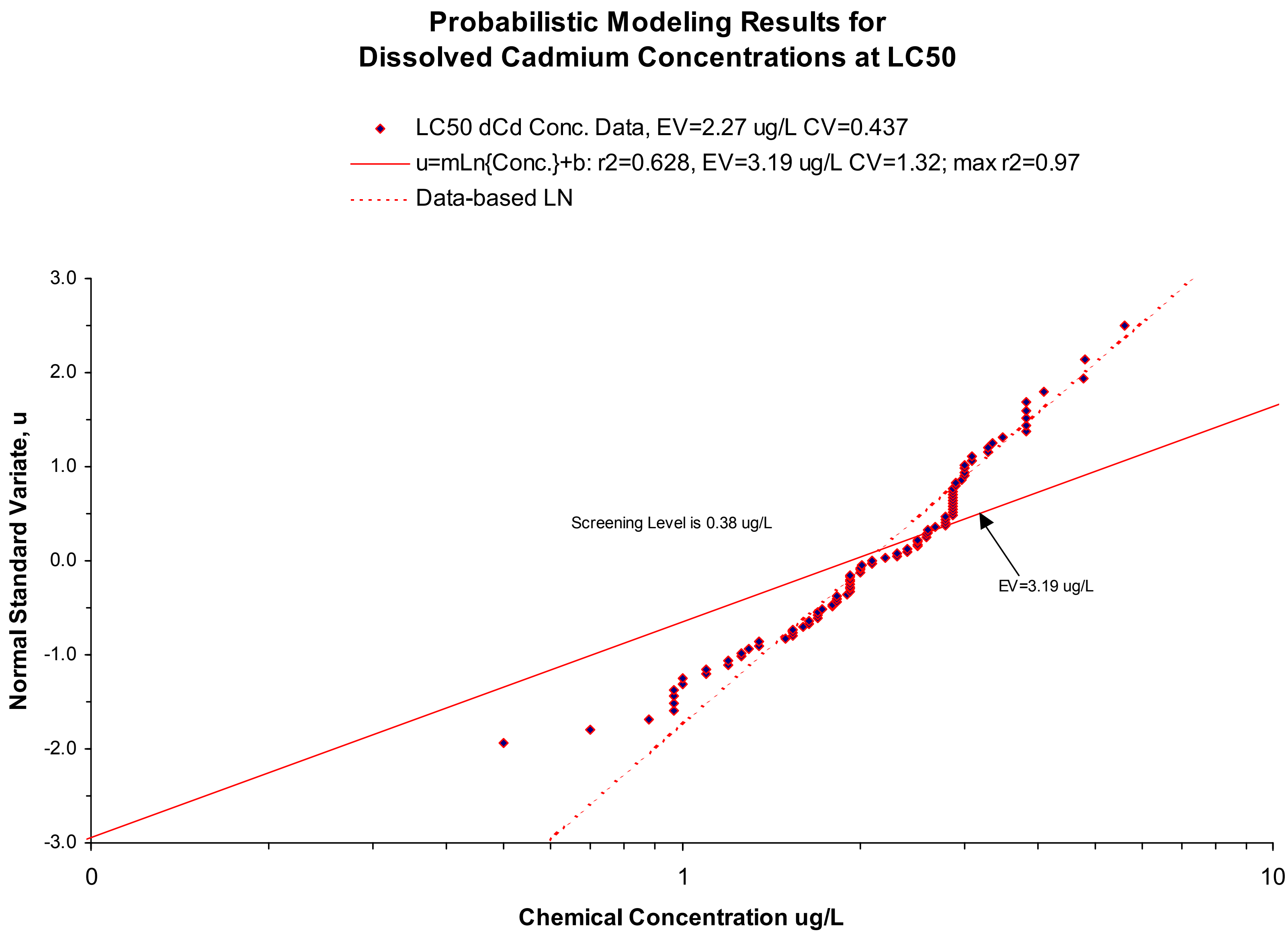
EPA REGION 10

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

Doc Control: 4162500.6615.05.a
Generation: 1

Main Stem Series
07/13/01

Figure 5.2-3



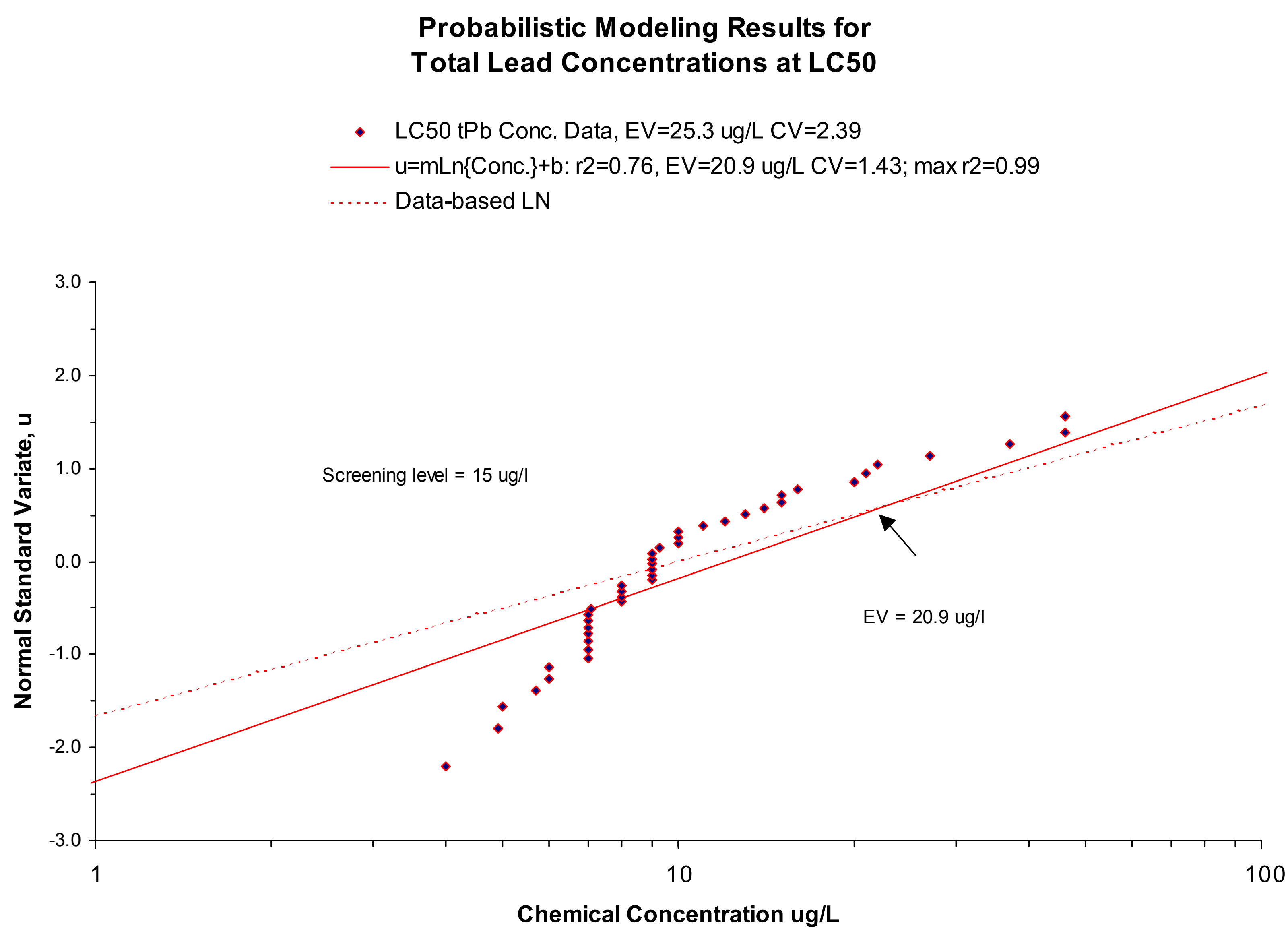
EPA REGION 10

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

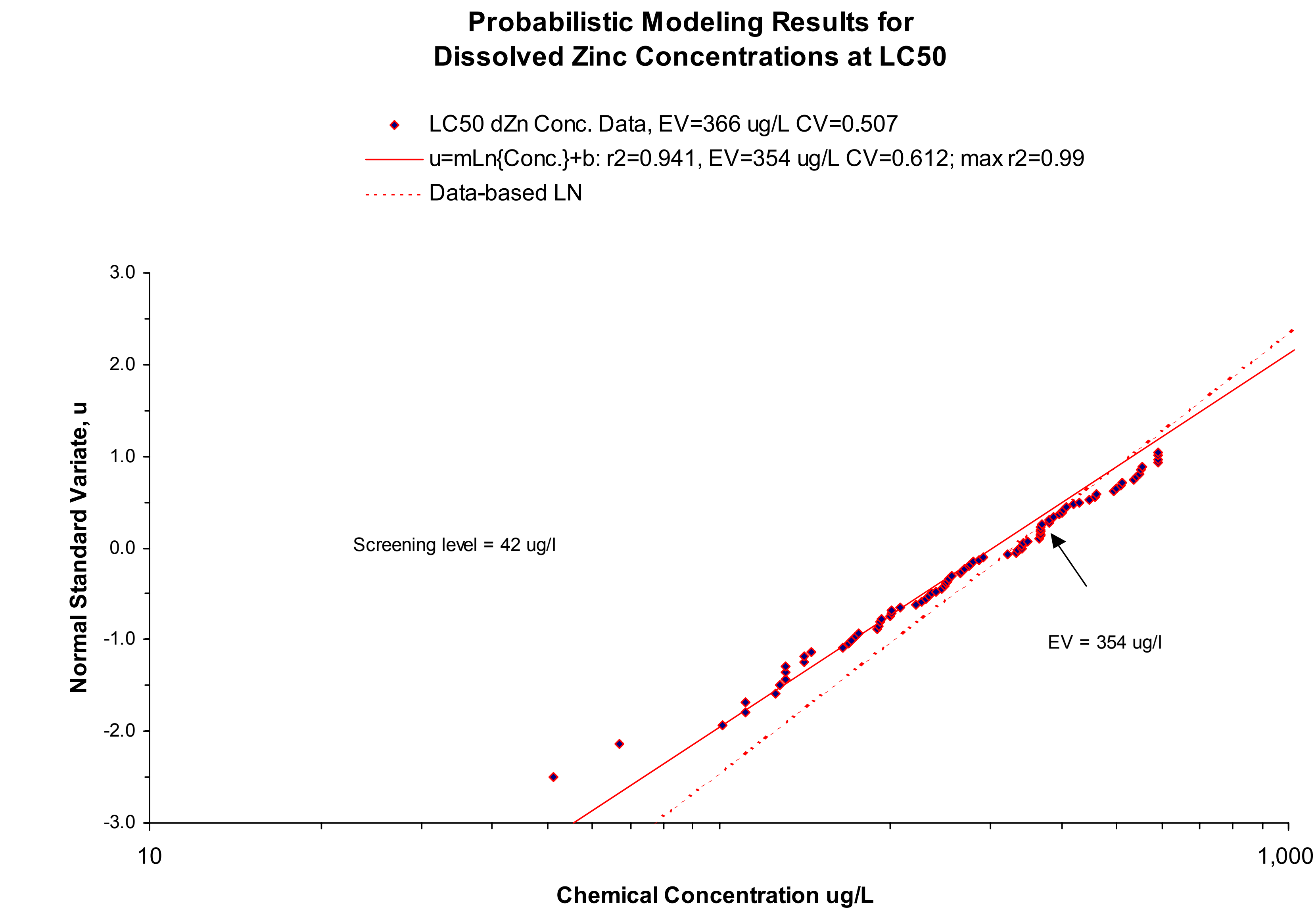
Doc Control: 4162500.6615.05.a
Generation: 1

Main Stem Series
07/13/01

Figure 5.2-4



EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc Control: 4162500.6615.05.a Generation: 1 Main Stem Series 07/13/01	Figure 5.2-5



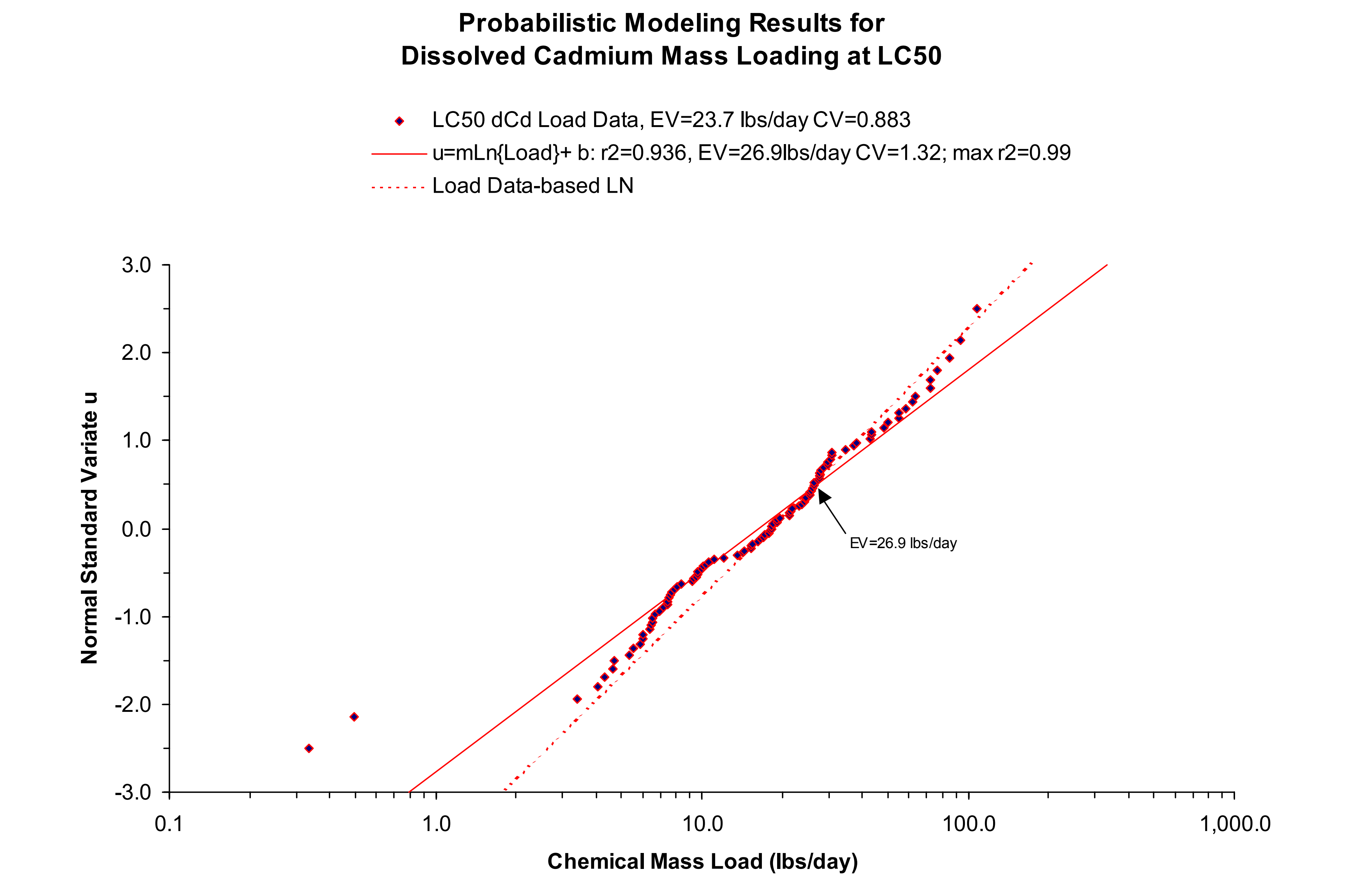
EPA REGION 10

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

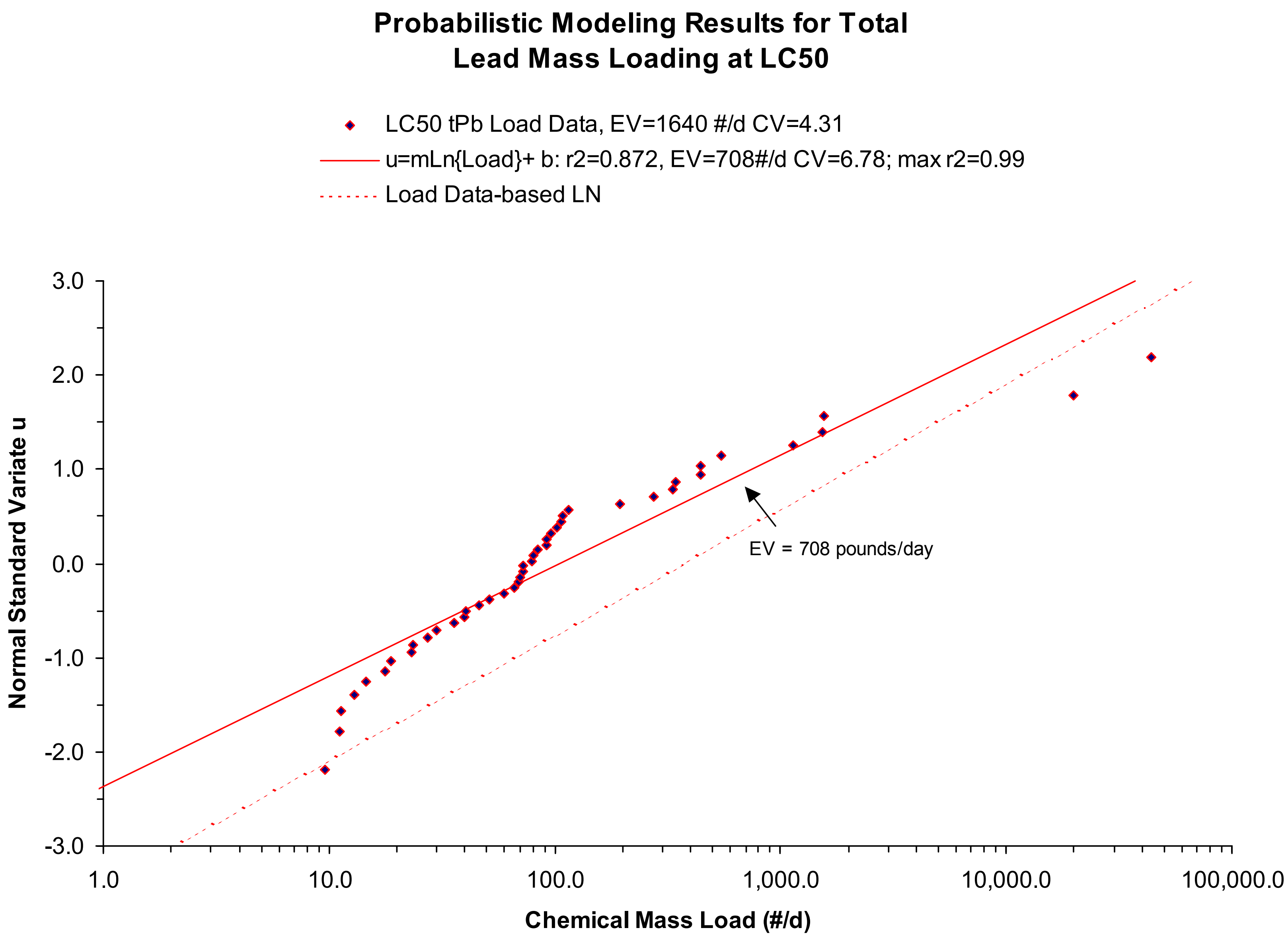
Doc Control: 4162500.6615.05.a
Generation: 1

Main Stem Series
07/13/01

Figure 5.2-6



EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc Control: 4162500.6615.05.a Generation: 1 Main Stem Series 07/13/01	Figure 5.2-7



EPA REGION 10

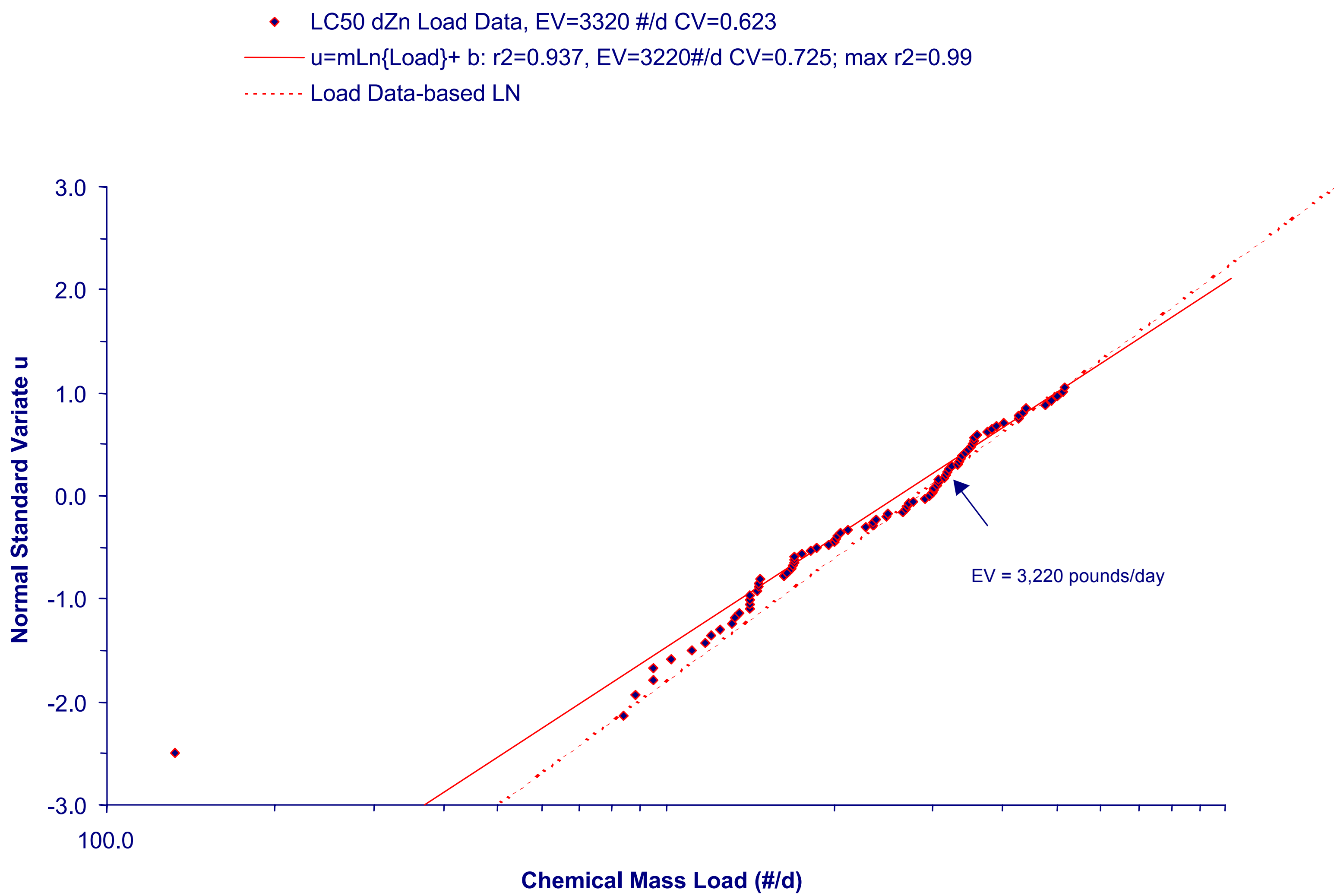
027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

Doc Control: 4162500.6615.05.a
Generation: 1

Main Stem Series
07/13/01

Figure 5.2-8

Probabilistic Modeling Results for Dissolved Zinc Mass Loading at LC50



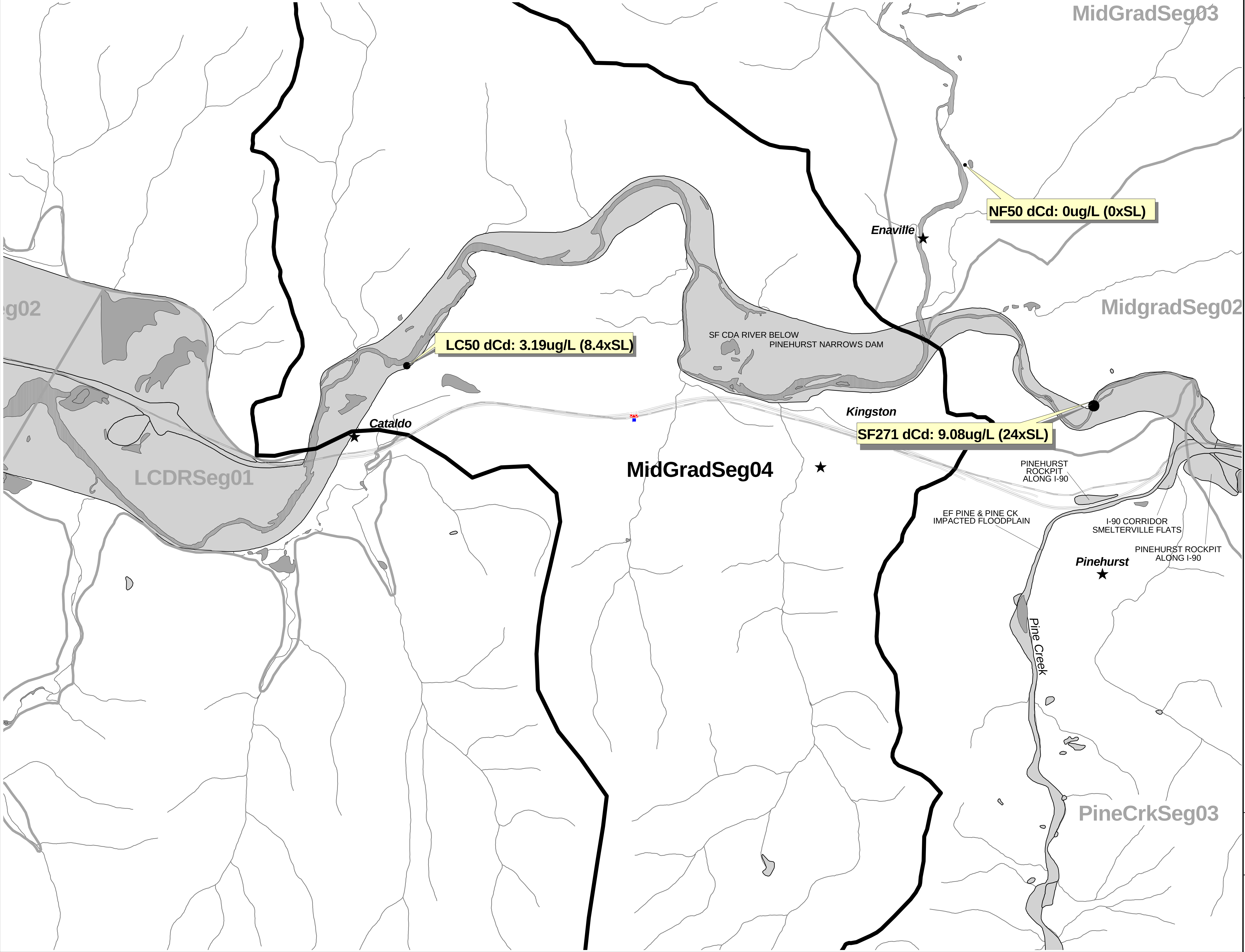


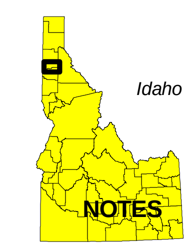
Figure 5.4-1
Main Stem Coeur d'Alene River Watershed Estimated Expected Values for Dissolved Cadmium Concentrations

LEGEND

Sampling Location
Concentration
LC50 dCd: 3.1ug/L (8.4xSL)
Analyte
Screening Level is 0.38 ug/L

Range of Dissolved Cadmium Concentrations in ug/L

- Range 0 - 2.5
- Range 2.5 - 5
- Range 5 - 10
- Range 10 - 15
- Range >15
- Stream
- Interstate 90
- City
- Main Stem Coeur d'Alene River Watershed
- River Segment
- Lake/River
- Source Area



Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL, and the Bureau of Land Management.

SCALE 1:36,000

0 0.5 Miles

N

027-RI-C0-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

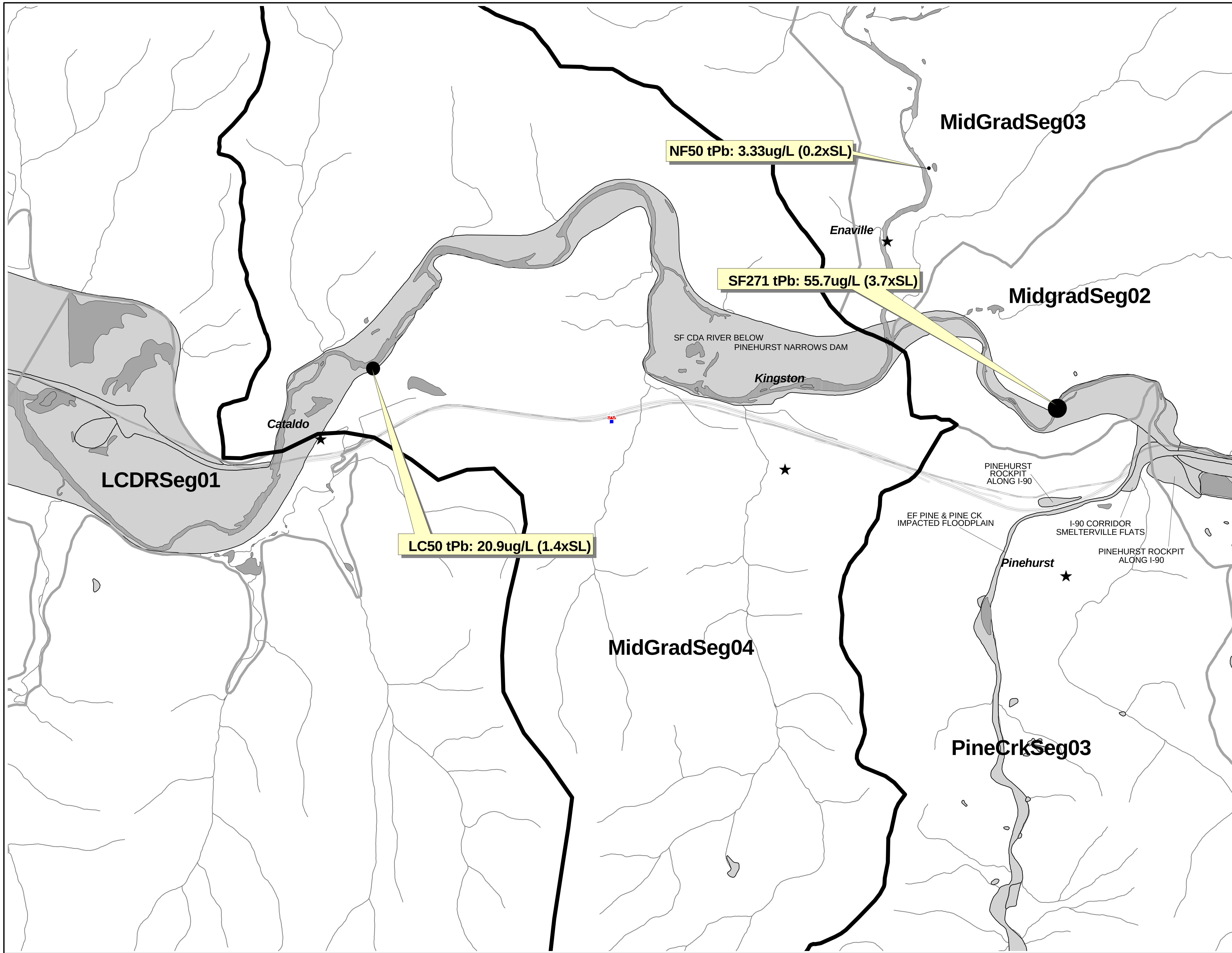
EPA REGION 10

Doc Control 4162500.6615.05a
Generation 1
n:\Projects\watersheds\mainstem\
|mainstem_ev7-26.apr
V:dCd concentrations
E:dCd
L: Final RI dCd Concentrations
7/17/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: July 17, 2001

Figure 5.4-2
Main Stem Coeur d'Alene River Watershed Estimated Expected Values for Total Lead Concentrations



LEGEND

Sampling Location

Concentration

LC50 tPb: 21ug/L (1xSL)

Analyte

Screening Level is 15 ug/L

Range of Total Lead Concentrations in ug/L

- Range 0 - 5
- Range 5 - 10
- Range 10 - 50
- Range 50 - 100
- Range >100

- Stream
- Interstate 90
- Road
- City
- Main Stem Coeur d'Alene River Watershed
- River Segment
- Lake/River
- Source Area

Idaho

Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL, and the Bureau of Land Management.

SCALE 1:36,000

0 0.5 Miles

N

027-RI-C0-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

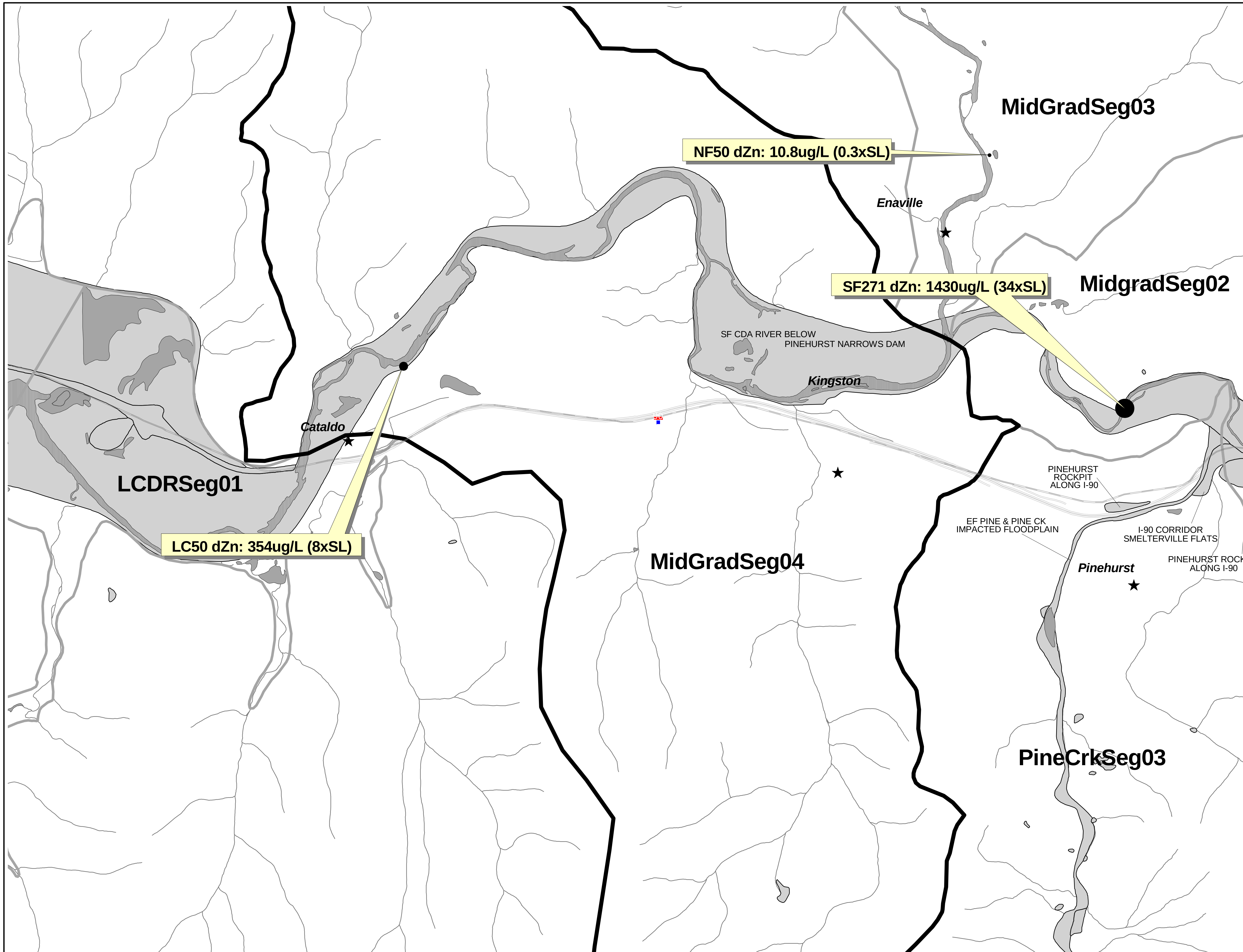
EPA REGION 10

Doc Control 4162500.6615.05.a
Generation 1
n:\Projects\watersheds\Mainstem\
|mainstem_ev_7-27.apr
V:tPb concentrations
E:tPb
L: Final RI tPb Concentrations
7/17/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: July 17, 2001

Figure 5.4-3
Main Stem Coeur d'Alene River Watershed Estimated Expected Values for Dissolved Zinc Concentrations



LEGEND

Sampling Location — Concentration

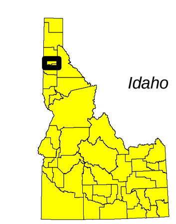
LC50 dZn: 354ug/L (8xSL)

Analyte — Screening Level is 42 ug/L

Range of Dissolved Zinc Concentrations in ug/L

- Range 0 - 100
- Range 100 - 500
- Range 500 - 1000
- Range 1000 - 1500
- Range >1500

- Stream
- Interstate 90
- Road
- City
- Main Stem Coeur d'Alene River Watershed
- River Segment
- Lake/River
- Source Area



NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL, and the Bureau of Land Management.

SCALE 1:36,000

0 0.5 Miles

N

027-RI-C0-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

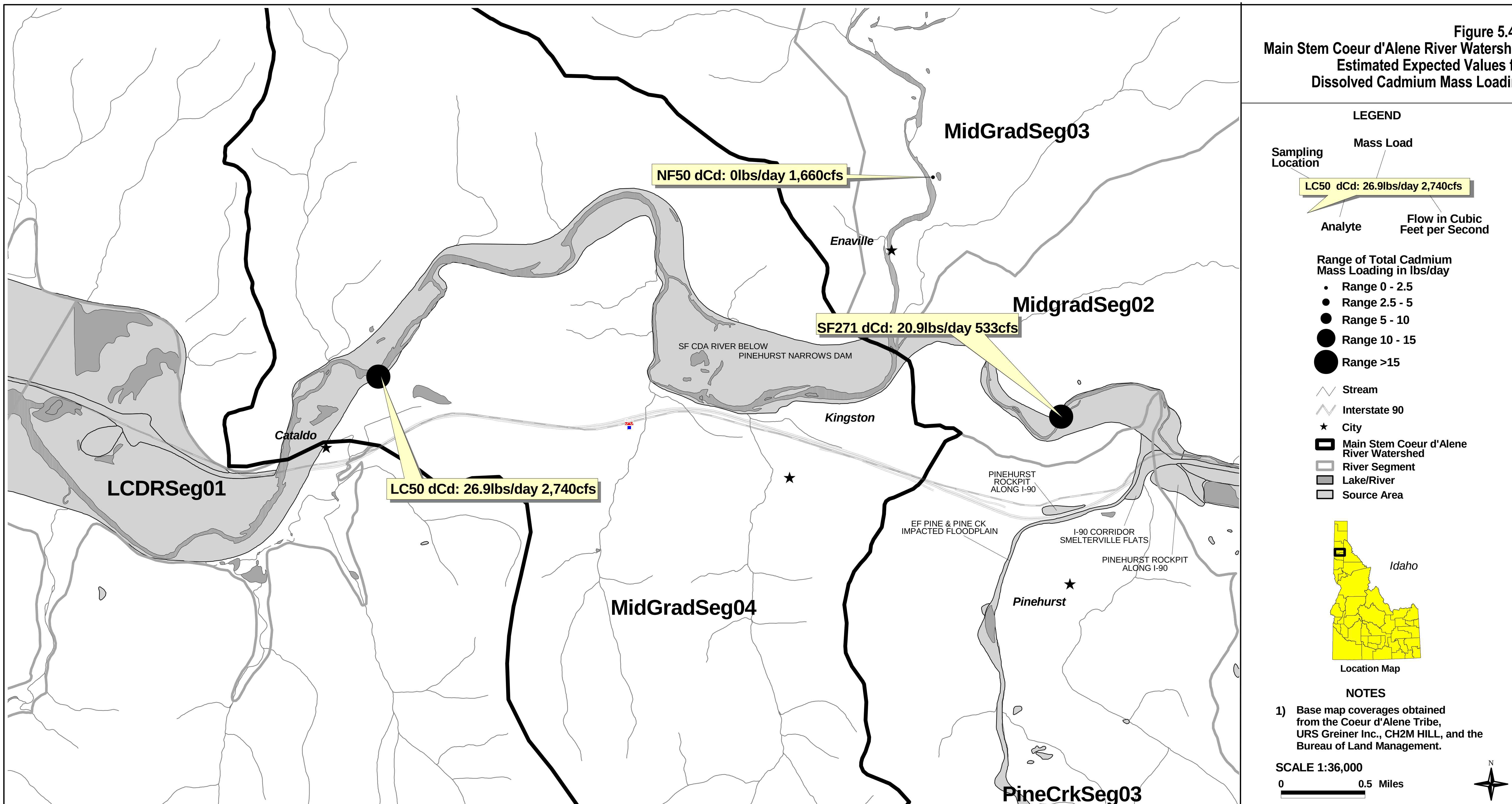
EPA
REGION 10

Doc Control 4162500.6615.05.a
Generation 1
n:\Projects\watersheds\Mainstem\mainstem_ev7-27.apr
V:dZn concentrations
E:dZn
L: Final RI dZn concentrations
7/17/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: July 17, 2001

Figure 5.4-4
Main Stem Coeur d'Alene River Watershed Estimated Expected Values for Dissolved Cadmium Mass Loading



NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL, and the Bureau of Land Management.

027-RI-C0-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

EPA REGION 10

Document Control 4162500.6615.05a
Generation 1
n:\Projects\watersheds\mainstem\
|Mainstem_ev7-27.apr
V:dCd Mass Loading
E:dCd
L: Final RI dCd Mass Loading
7/25/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: July 25, 2001

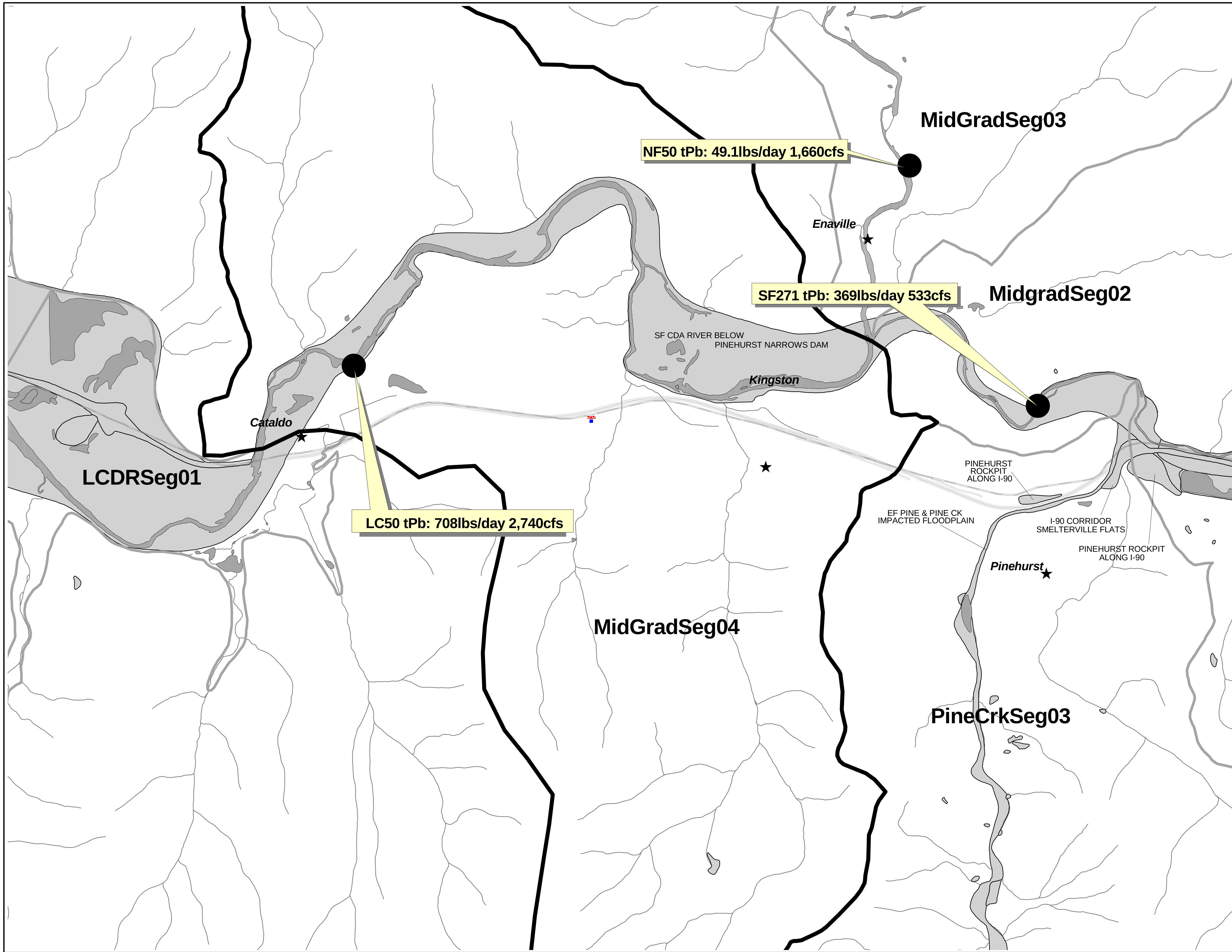


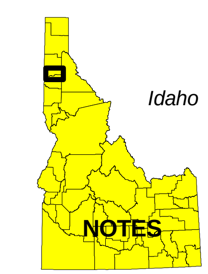
Figure 5.4-5
Main Stem Coeur d'Alene River Watershed
Estimated Expected Values for
Total Lead Mass Loading

LEGEND

Sampling Location
Mass Load
LC50 tPb: 708lbs/day 2,740cfs
Analyte
Flow measured in Cubic Feet per Second

Range of Total Lead Mass Loading in lbs/day
- Range 0 - 5
- Range 5 - 10
- Range 10 - 50
- Range 50 - 100
- Range >100

- Stream
- Interstate 90
- Road
- City
- Main Stem Coeur d'Alene River Watershed
- River Segment
- Lake/River
- Source Area



Location Map

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL, and the Bureau of Land Management.

SCALE 1:36,000
0 0.5 Miles

N

027-RI-C0-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

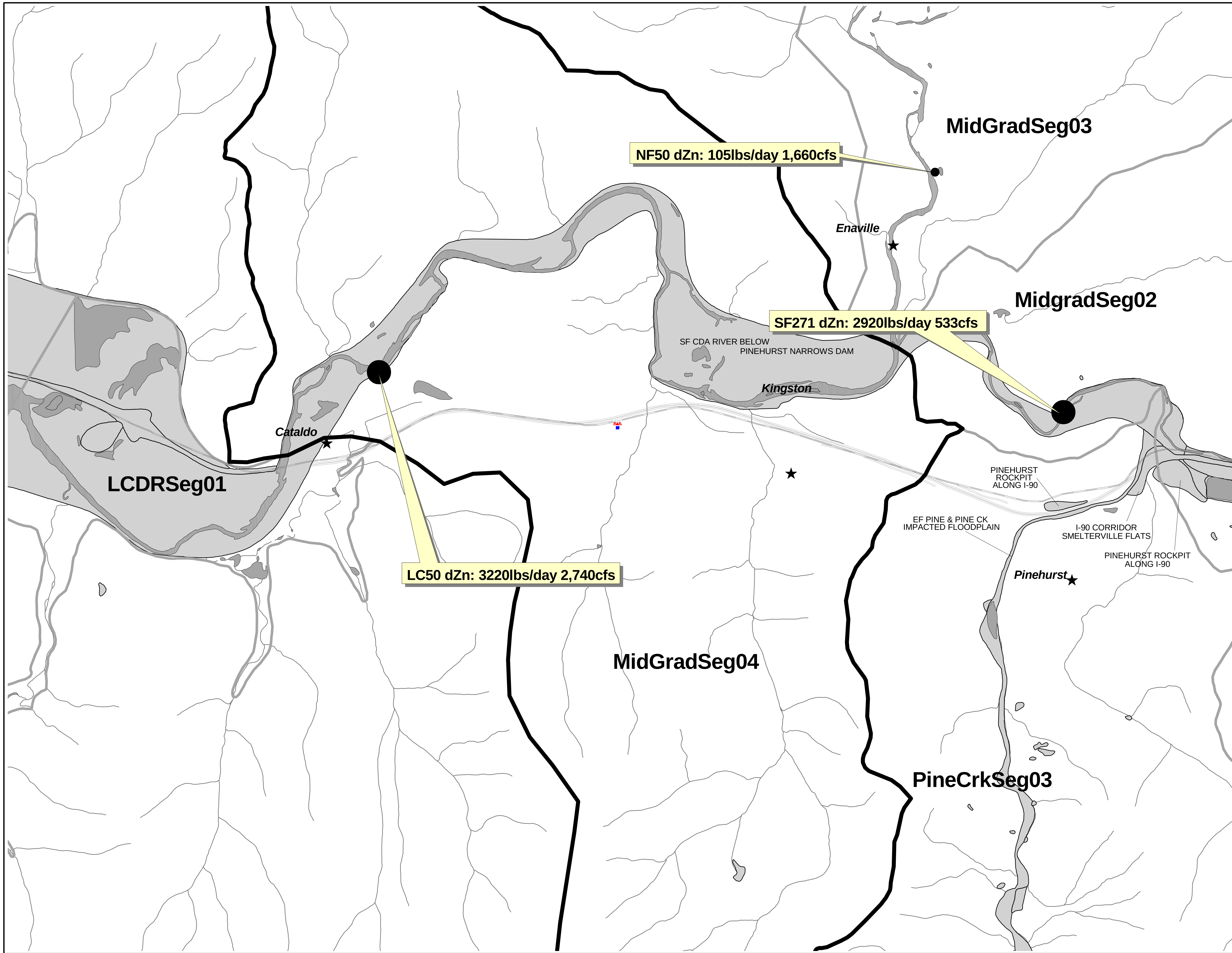
EPA REGION 10

Doc Control 4162500.6615.05.a
Generation 1
n:\Projects\watersheds\mainstem\mainstem_7-27.apr
V:tPb massloading
E:tPb
L: FInal RI tPb Massloading
7/17/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: July 17, 2001

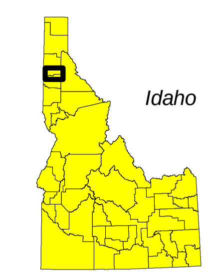
Figure 5.4-6
Main Stem Coeur d'Alene River Watershed
Estimated Expected Values for
Dissolved Zinc Mass Loading



LEGEND

Sampling Location — Mass Load
LC50 dZn: 3,220lbs/day 2,740cfs
Analyte — Flow measured in Cubic Feet per Second

Range of Dissolved Zinc Mass Loading in lbs/day
- Range 0 - 100
- Range 100 - 500
- Range 500 - 1000
- Range 1000 - 1500
- Range >1500
- Stream
- Road
- Interstate 90
- City
- Main Stem Coeur d'Alene River Watershed
- River Segment
- Lake/River
- Source Area



Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL, and the Bureau of Land Management.

SCALE 1:36,000

0 0.5 Miles

N

027-RI-C0-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

EPA REGION 10

Doc Control 4162500.6615.05.a
Generation 1
n:\Projects\watersheds\mainstem\
|mainstem_ev7-27.apr
V:dZn Mass Loading
E:dZn
L: Final RI dZn Mass Load
7/17/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: July 17, 2001

Table 5.1-1
Instantaneous Metal Loading Values for the Coeur d'Alene River at Cataldo for Sampling Events From May 1991 to May 1999

Metal	Loading (pounds/day)
Dissolved Cadmium	40.2
Total Lead	20,131
Dissolved Lead	274
Dissolved Zinc	5,806

Source: USGS 2000

Table 5.2-1
Estimated Expected Values of Concentrations and Loads Compared to Screening Levels and TMDLs for the Main Stem

Sampling Location	Concentration (µg/L)			Mass Loading (pounds/day)			Discharge (cfs)
	Dissolved Cadmium	Total Lead	Dissolved Zinc	Dissolved Cadmium	Total Lead	Dissolved Zinc	
Screening Level or TMDL[a]	0.38	15	42	13.7	20.0	1,200	NA
NF50 (North Fork)	NA	3.33 (4.7)	10.8 (1.86)	NA	**49.1** (21.6)	105 (4.12)	1,660 (1.68)
SF271 (South Fork)	**9.08** (0.629)	**55.7** (1.34)	**1,430** (0.633)	**20.9** (0.873)	**369** (5.53)	**2,920** (0.644)	533 (1.37)
LC50 (Main Stem)	**3.19** (1.32)	**20.9** (1.43)	**354** (0.612)	**26.9** (1.32)	**708** (6.78)	**3,220** (0.725)	2,740 (1.54)

[a]TMDLs listed are the 90th percentile TMDLs for the LCDR at Harrison.

Note:
NA - not applicable
Bold indicates exceedance of screening level or TMDL

Table 5.2-2
Estimated Gain or Loss (EV[X]) in Discharge

Reach - between location Xi and Xj (# of samples)	Estimated expected value of gain or loss (EV[X]) in discharge, cfs	Coefficient of variation (CV) for reach ($p_{xi,xj}$ = 0.9)
SF271 (111) to LC50 (102)	2,207	1.6

Table 5.2-3
Estimated Gain or Loss (EV[X]) for Dissolved Zinc Concentrations (µg/L) and Dissolved Load [pounds/day, (#/day)]

Reach - between location Xi and Xj (# of samples)	Estimated expected value of increase or decrease in the concentration of dissolved zinc (µg/L)	Estimated coefficient of variation (CV) for the dissolved zinc ($p_{xi,xj}$ = 0.9)	Estimated expected value of gain or loss in the dissolved zinc load (#/day)	Estimated coefficient of variation (CV) for the dissolved zinc load ($p_{xi,xj}$ = 0.9)
SF271 (111) to LC50 (102)	-1,076	0.7	300	3.5

Table 5.2-4
Estimated Gain or Loss (EV[X]) for Total Lead Concentrations (µg/L) and Total Load [pounds/day, (#/day)]

Reach - between location Xi and Xj (# of samples), [segment]	Estimated expected value of increase or decrease in the total concentration of lead (µg/L)	Estimated Coefficient of variation (CV) for total lead concentrations	Estimated expected value of gain or loss in the total lead load (#/day)	Estimated coefficient of variation (CV) for the total lead load
SF271 (111) to LC50 (102)	-34.8	1.4	339	9.1

Table 5.2-5
Estimated Gain or Loss (E[V]) for Dissolved Cadmium Concentrations (µg/L) and Load [pounds/day, (#/day)]

Reach - between location Xi and Xj (# of samples), [segment]	Estimated expected value of increase or decrease in the concentration of dissolved cadmium (µg/L)	Estimated coefficient of variation (CV) for the dissolved cadmium (pxi,xj = 0.9)	Estimated expected value of gain or loss in the dissolved cadmium load (#/day)	Estimated coefficient of variation (CV) for the dissolved cadmium load (pxi,xj = 0.9)
SF271 (111) to LC50 (102)	-5.89	0.5	6	3.4

6.0 REFERENCES

Section 1.0—Introduction

Bureau of Land Management (BLM). 1999. Source Area ARCINFO GIS Coverage, Coeur d'Alene Field Office, Coeur d'Alene, Idaho. Received by URS, July 1999.

Liverman, E. 2000. Personal Communication with Susan Alvarez, REI. RE: USEPA Cleanup Actions in the Coeur d'Alene Basin. October 12, 2000.

MFG. 1999. Response Action Design Drawings. Attachment D to the Union Pacific Rail Road Wallace-Mullan Branch Response Action. Prepared for UPRR by McCully, Frick and Gilman. December.

MFG. 2000. 2000 Project Construction Schedule- Revised October 6. Attachment to Memorandum from McCully Frick and Gilman to Ed Moreen, Government's Project Coordinator, with Submission of Draft Construction Schedule. October 6.

USEPA. 2000. Interim Report for the Time-Critical Removal Actions Conducted at Residential and Common Use Areas During 1997. Prepared by the U.S. Army Corps of Engineers, Bunker Hill Resident Office and Morrison Knudson Corporation for the USEPA Region 10. June.

USEPA. 1999. Interim Report for the Time-Critical Removal Actions Conducted at Residential Properties During 1998. Prepared by Morrison Knudson Corporation for the USEPA Region 10. February.

USEPA. 1988. Guidance Document for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final. OSWER Directive 9355-3-01. Office of Emergency and Remedial Response. Washington, D.C. October 1988.

Section 2.1—Geology

Bond J. G., C.H. Wood. 1978. Geologic Map of Idaho. Idaho Department of Lands, Bureau of Mines and Geology, with contributions from United States Geologic Survey.

Maest, A., D.R. Heinle, W.A. Marcus, and D.R. Ralston, 1999. *Expert Report: Release, Transport, and Environmental Fate of Hazardous Substances in the Coeur d'Alene River Basin, Idaho*. Prepared by Stratus Consulting, Inc., for the U.S. Department of Justice. September 1, 1999.

Mitchell, V., and E.H. Bennett. 1983. *Production Statistics for the Coeur d'Alene Mining District, Shoshone County, Idaho -- 1884-1980.* Idaho Geologic Survey Technical Report 83-3, May.

Science Applications International Corporation (SAIC). 1993. *Draft Mine Sites Fact Sheets for the Coeur d'Alene River Basin*. Prepared by SAIC, Bothell, Washington for US Environmental Protection Agency, Region 10. December 1993.

Section 2.2—Hydrogeology

Chamberlain, V. and B. Williams. 1998. An Investigation of Hydrology and Natural Geochemical Attenuation of Metals by Natural Wetlands and other Native Materials in the Cataldo Flats Region of the Coeur d'Alene River, North Idaho. University of Idaho. February 1998.

Idaho Department of Water Resources (IDWR). 2000. *Water Right Point-of-Delivery (POD) Index, July 14, 2000*.

McCulley, Frick & Gilman, Inc. (MFG). 1998. *Bunker Hill Superfund Site Remedial Investigation Report*. Prepared by MFG, Boulder, Colorado, for Gulf Resources and Chemical Corporation/Pintlar Corporation. May 1, 1992.

Norbeck, P. M. 1974. *Water Table Configuration and Aquifer and Tailings Distribution, Coeur d'Alene Valley, Idaho*. M.Sc. Thesis, University of Idaho, Moscow, Idaho.

Williams, R.E. 1989. *Evaluation of Waste and Water Contamination for Closure of a Hard Rock Mine Complex*. Annual Report to U.S. Bureau of Mines (Cooperative Agreement No. C0278001), submitted June 30, 1989.

Section 2.3—Surface Water Hydrology

Federal Insurance Administration (FIA). 1979. Flood Insurance Study, Shoshone County, ID, March 1979.

U.S. Geological Survey (USGS). 2000. Mean Daily Discharge Data: Available, World Wide Web, URL: http://waterdata.usgs.gov/nwis-w/ID/.

U.S. Geological Survey (USGS). 1998. PEAKFQ version 2.4, available at: http//www.water.usgs.gov/Software/

U.S. Geological Survey (USGS). 1982. Guidelines For Determining Flood Flow Frequency, Bulletin #17B.

Western Regional Climate Center (WRCC). 2000. Climate Summary For Stations in Idaho: Available, World Wide Web, URL: http://www.wrcc.dri.edu/summary/climsmid.html

Section 3.0—Sediment Transport Processes

Dunne, T. and Leopold, L.B., 1978, Water in environmental planning; New York, W.H. Freeman and Co., 818 p.

Grant L. A. 1952. A history of the Cataldo Dredge. The Fourth Annual Pacific Northwest Industrial Waste Proceedings, Washington State Collage, Pullman.

Leopold, L.B., Wolman, M.G., and Miller, J.P. 1992. Fluvial processes in geomorphology; New York, Dover Publications, Inc., 522 p.

Rosgen, D. and Silvey, H.L. (ill.). 1996. Applied river morphology; Pagosa Springs, CO., Wildland Hydrology.

URS Greiner, Inc. and CH2M HILL, Inc. (URSG and CH2M HILL). 1999. Aerial photograph image library for the Bunker Hill Basin-Wide RI/FS, Version 1.0 [CD-Rom], prepared for U.S. Environmental Protection Agency, Region 10, dated March 22, 1999, 1 disk.

U.S. Department of Agriculture (USDA). 1991. Aerial photographs, dated August 24, 1991.

———. 1984. Aerial photographs, dated August 8, 1984.

Section 4.0—Nature and Extent of Contamination

Bureau of Land Management (BLM). 1999. Source Area ARCINFO GIS Coverage. Coeur d'Alene Field Office, Coeur d'Alene, Idaho. Received by URS Corporation, Inc., July 1999.

Chamberlain, V. and B. Williams. 1998. An Investigation of Hydrology and Natural Geochemical Attenuation of Metals by Natural Wetlands and other Native Materials in the Cataldo Flats Region of the Coeur d'Alene River, North Idaho. University of Idaho. February 1998.

Section 4.2—Surface Water Mass Loading

United States Geological Survey (USGS). 2000. Loads and Concentrations of Cadmium, Lead, Zinc Measured near the peak of the 1999 snowmelt runoff hydrograph at 42 stations Coeur d'Alene River Basin, Idaho, January 2000.

Section 5.0—Fate and Transport

United States Environmental Protection Agency (USEPA). 2000. Draft Final TMDL Package. USEPA Region 10. May 3, 2000.

United States Geological Survey (USGS). 2000. Loads and Concentrations of Cadmium, Lead, Zinc and Nutrients During the 1999 Water Year Within the Spokane River Basin, Idaho and Washington. March 2000.

ATTACHMENT 1
Data Source References

Data Source References

Data Source References[a]	Data Source Name	Data Source Description	Reference
2	URS FSPA Nos. 1, 2, and 3	Fall 1997: Low Flow and Sediment Sampling	URS Greiner Inc. 1997. Field Sampling Plan Addendum 1 Sediment Coring in the Lower Coeur d'Alene River Basin, Including Lateral Lakes and River Floodplains
			URS Greiner Inc. 1997. Field Sampling Plan Addendum 2 Adit Drainage, Seep and Creek Surface Water Sampling
			URS Greiner Inc. 1997. Field Sampling Plan Addendum 3 Sediment Sampling Survey in the South Fork of the Coeur d'Alene River, Canyon Creek, and Nine-Mile Creek
3	URS FSPA No. 4	Spring 1998: High Flow Sampling	URS Greiner Inc. 1998. Field Sampling Plan Addendum 4 Adit Drainage, Seep and Creek Surface Water Sampling; Spring 1998 High Flow Event
4	MFG Historical Data Spring 1991	Spring 1991: High Flow Sampling	McCulley, Frick & Gillman, Inc. 1991. Upstream Surface Water Sampling Program Spring 1991 High Flow Event, South Fork Coeur d'Alene River Basin above Bunker Hill Superfund Site: Tables 1 and 2
5	MFG Historical Data Fall 1991	Fall 1991: Low Flow Sampling	McCulley, Frick & Gillman, Inc. 1992. Upstream Surface Water Sampling Program Fall 1991 Low Flow Event, South Fork Coeur d'Alene River Basin above Bunker Hill Superfund Site: Tables 1 and 2
6	EPA/Box Historical Data	Superfund Site Groundwater and Surface Water Data	CH2MHill. 1997. Location of Wells and Surface Water Sites, Bunker Hill Superfund Site. Fax Transmission of Map August 11, 1998
			Environmental Protection Agency. 1998. E-mail from Ben Cope July 15, 1998. Subject: 2 Datasets File Attached: BOXDATA.WK4
7	IDEQ Historical Data	IDEQ Water Quality Data	Idaho Department of Environmental Quality. 1998. Assortment of files from Glen Pettit for water years 1993 through 1996
			Idaho Department of Environmental Quality. 1998. E-mail from Glen Pettit October 6, 1998 Subject: DEQ Water Quality Data Files Attached: 1998 trend Samples.xls, 1997 trend Samples.xls

Data Source References (Continued)

Data Source References[a]	Data Source Name	Data Source Description	Reference
8	EPA/NPDES Historical Data	Water Quality based on NPDES Program	Environmental Protection Agency. 1998. E-mail from Ben Cope August 11, 1998/September 2, 1998. Subject: Better PCS Data Files/Smelterville. Attached: PCS2.WK4, PCSREQ.698/TMT-PLAN.XLS
			Environmental Protection Agency. 1998. E-mail from Ben Cope August 5, 1998. Subject: State of Idaho Lat/Longs File Attached: PAT.DBF
			Environmental Protection Agency. 1998. E-mail from Ben Cope July 15, 1998. Subject: 2 Datasets File Attached: PCSDATA.WK4
10	URS FSPA No. 5	Common Use Areas Sampling	URS Greiner Inc. 1998. Field Sampling Plan Addendum 5 Common Use Areas: Upland Common Use Areas and Lower Basin Recreational Beaches; Sediment/Soil, Surface Water, and Drinking Water Supply Characterization
11	URS FSPA No. 8	Source Area Sampling	URS Greiner Inc. 1998. Field Sampling Plan Addendum 8 Tier 2 Source Area Characterization Field Sampling Plan
12	Historical Groundwater Data from MFG	1997 Annual Groundwater Data Report Woodland Park	McCulley, Frick & Gillman. 1998. 1997 Annual Groundwater Data Report Woodland Park
13	Historical Data from US Forest Service, Idaho Geological Survey and others	Historical Data on Inactive Mine Sites USFS, IGS and CCJM, 1994-1997, Prichard Creek, Pine Creek and Summit Mining District	Mackey K, Yarbrough, S.L. 1995. Draft Removal Preliminary Assessment Report Pine Creek Millsites, Coeur d'Alene District, Idaho, Contract No. 1422-N651-C4-3049
			Idaho Geological Survey. 1999. Site Inspection Report for the Abandoned and Inactive Mines in Idaho on U.S. Forest Service Lands (Region 1), Idaho Panhandle National Forest Vol. I, Prichard Creek and Eagle Creek Drainages
			Idaho Geological Survey. 1999. Site Inspection Report for the Abandoned and Inactive Mines in Idaho on U.S. Forest Service Lands (Region 1), Idaho Panhandle National Forest Vol. III, Coeur d'Alene River Drainage Surrounding the Coeur d'Alene Mining District (Excluding the Prichard Creek and Eagle Creek Drainages)
			Idaho Geological Survey. 1999. Site Inspection Report for the Abandoned and Inactive Mines in Idaho on U.S. Forest Service Lands (Region 1), Idaho Panhandle National Forest Vol. IV, Prichard Creek and Eagle Creek Drainages

Data Source References (Continued)

Data Source References[a]	Data Source Name	Data Source Description	Reference
13	Historical Data from US Forest Service, Idaho Geological Survey and others (continued)		Idaho Geological Survey. 1999. Site Inspection Report for the Abandoned and Inactive Mines in Idaho on U.S. Forest Service Lands (Region 1), Idaho Panhandle National Forest Vol. V, Coeur d'Alene River Drainage Surrounding the Coeur d'Alene Mining District (Excluding the Prichard Creek and Eagle Creek Drainages) Part 2 Secondary Properties
			US Forest Service. 1995. Pilot Inventory of Inactive and Abandoned Mine Lands, East Fork Pine Creek Watershed, Shoshone County, Idaho
14	Historical Sediment Core Data: University of Idaho (Thesis papers)	Historical Lateral Lakes Sediment Data from F. Rabbi and M.L. Hoffman	Characterization of Heavy Metal Contamination in Two Lateral Lakes of the Lower Coeur d'Alene River Valley, A thesis by M.L. Hoffmann, May 1995
			Trace Element Geochemistry of Bottom Sediments and Waters from the Lateral Lakes of Coeur d'Alene River, A Dissertation by F. Rabbi, May 1994
15	URS FSPA No. 9	Source Area Characterization; Field XRF Data	CH2M Hill and URS Greiner. 1998. Field Sampling Plan Addendum 9 Delineation of Contaminant Source Areas in the Coeur d'Alene Basin using Survey and Hyperspectral Imaging Techniques
16	Historical Sediment Data	Electronic Data compiled by USGS	U.S. Geological Survey. 1992. Effect of Mining-Related Activities on the Sediment-Trace Element Geochemistry of Lake Coeue d'Alene, Idaho, USA--Part 1: Surface Sediments, USGS Open-File Report 92-109, Prepared by A.J. Horowitz, K.A. Elrick, and R.B. Cook
			US Geological Survey. 2000. Chemical Analyses of Metal-Enriched Sediments, Coeur d'Alene Drainage Basin, Idaho: Sampling, Analytical Methods, and Results. Draft. October 13, 2000. Prepared by S.E. Box, A.A. Bookstrom, M. Ikramuddin, and J. Lindsey. Samples collected from 1993 to 1998.

Data Source References (Continued)

Data Source References[a]	Data Source Name	Data Source Description	Reference
17	USGS Spokane River Basin Sediment Samples	Surface Sediment Samples Collected by USGS in the Spokane River Basin	Environmental Protection Agency. 1999. Data Validation Memorandum and Attached Table from Laura Castrilli to Mary Jane Nearman dated June 9, 1999. Subject: Coeur d'Alene (Bunker Hill) Spokane River Basin Surface Sample Samples, USGS Metals Analysis, <63 um fraction, Data Validation, Samples SRH7-SRH30
18	USGS Snomelt Surface Water Data	Surface Water Data from 1999 Snomelt Runoff Hydrograph	USGS. 1999. USGS WY99.xls Spreadsheet dowloaded from USGS (Coeur d'Alene Office) ftp site
			USGS. 2000. Concentrations and Loads of Cadmium, Lead and Zinc Measured near the Peak of the 1999 Snomelt Runoff Hydrograph at 42 Stations, Coeur d'Alene River Basin Idaho
			USGS. 2000. Concentrations and Loads of Cadmium, Lead and Zinc Measured on the Ascending and Descending Limbs of the 1999 Snomelt Runoff Hydrograph at Nine Stations, Coeur d'Alene River Basin Idaho
22	MFG Report on Union Pacific Railroad Right-of-Way Soil Sampling	Surface and Subsurface Soil Lead Data	MFG. 1997. Union Pacific Railroad Wallace Branch, Rails to Trails Conversion, Right-of-Way Soil Sampling, Summary and Interpretation of Data. McCulley, Frick and Gilman, Inc. March 14, 1997
23	URS FSPA No. 11A	Source Area Groundwater and Surface Water Sampling	URS Greiner Inc. 1999. Field Sampling Plan Addendum 11A Tier 2 Source Area Characterization
24	URS FSPA No. 15	Common Use Area Sampling—Spokane River	URS Greiner Inc. 1999. Field Sampling Plan Addendum 15 Spokane River - Washington State Common Use Area Sediment Characterization
25	URS FSPA No. 18	Depositional and Common Use Area Sediment Sampling - Spokane River	URS Greiner Inc. 2001. Final Field Sampling Plan Addendum No. 18, Fall 2000 Field Screening of Sediment in Spokane River Depositional Areas, Summary of Results. Revision 1. January 2001.
28	USGS National Water Quality Assessment database	Surface water data for sampling location NF50 at Enaville, Idaho	USGS. 2001. USGS National Water Quality Assessment database: http://infotrek.er.usgs.gov/pls/nawqa/nawqa.wwv_main.gohome. Data retrieved on August 2, 2001 for station 12413000, NF Coeur d'Alene River At Enaville, Idaho.

[a]Reference Number is the sequential number used as cross reference to associate chemical results in data summary tables with specific data collection efforts.

ATTACHMENT 2
Data Summary Tables

ABBREVIATIONS USED IN DATA SUMMARY TABLE

LOCATION TYPES:

AD adit
BH borehole
FP flood plain
GS ground surface/near surface
HA hand auger boring
LK lake/pond/open reservoir
OF outfall/discharge
RV river/stream
SP stockpile
TL tailings pile

QUALIFIERS:

U Analyte was not detected above the reported detection limit
J Estimated concentration

DATA SOURCE REFERENCES:

Data source references listed in Attachment 1 are shown in the data summary tables in the "Ref" column.

Data Summary Table
Main Stem Coeur d`Alene - segment MidGradSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Soil (mg/kg)														
CUA07716	GS	10	08/13/1998	0	33.3	128	18	125	87200	4020	6690	2.5	10.7	2950
CUA07717	GS	10	08/13/1998	0	16.5	73	13.9	83	39900	2660	3000	2.4	6.2	1740
CUA07718	GS	10	08/13/1998	0	26.7	151	15.2	112	76600	3590	5830	2.5	10	2470
CUA07719	GS	10	08/13/1998	0		133		105						
CUA07719	GS	10	08/13/1998	0	21.8		14.6		68400	3610	5450	2.7	11.7	2290
CUA07720	GS	10	08/13/1998	0	23.9	155	17.2	119	83800	3510	6440	2.4	14.2	2780
LC10011	RV	22	---	0.5						5240				
LC10012	RV	22	---	0.5						2810				
LC10061	RV	22	---	0.5						2450				
LC10062	RV	22	---	0.5						2900				
LC10063	RV	22	---	0.5						227				
LC10064	RV	22	---	0.5						273				
LC11233	FP	16	---			84	20	71.7	37900	2400	2860			1600
LC11234	FP	16	---			74.6	12.8	60.3	38700	2340	3310			1180
Subsurface Soil (mg/kg)														
LC10011	RV	22	---	1						15400				
LC10011	RV	22	---	1.5						11000				
LC10012	RV	22	---	1						7720				
LC10012	RV	22	---	1.5						17000				
LC10061	RV	22	---	1						682				
LC10061	RV	22	---	1.5						364				
LC10062	RV	22	---	1						182				
LC10062	RV	22	---	1.5						273				
LC10063	RV	22	---	1						136				
LC10063	RV	22	---	1.5						91				
LC10064	RV	22	---	1						136				
LC10064	RV	22	---	1.5						136				
Sediment (mg/kg)														
CUA0771	RV	10	08/13/1998	0	64.3	266	63.3	265	174000	* 6190	14800	0.3	26.3	6260
CUA07710	RV	10	08/13/1998	0	26.6	107	23.5	106	75500	3460	6830	2.7	7.7	3450
CUA07712	RV	10	08/13/1998	0	23.2	113	13.6	98.4	77700	3050	6130	2.2	11.1	2240
CUA07713	RV	10	08/13/1998	0	28.7	123	21.4	120	77000	3670	6290	2.8	11.8	3320
CUA07714	RV	10	08/13/1998	0	24.8	104	22.7	114	76400	3850	6960	2.6	12.5	3420
CUA07715	RV	10	08/13/1998	0	17.8	93.9	19	98.7	49200	3010	3240	2.5	8.6	2280

Data Summary Table
Main Stem Coeur d`Alene - segment MidGradSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Sediment (mg/kg)														
CUA0772	RV	10	08/13/1998	0	53.9	209	29.6	216	120000	* 6360	9510	0.35	19.5	4810
CUA0773	RV	10	08/13/1998	0	46.6	134	23	158	91700	* 5160	7460	2.6		3480
CUA0773	RV	10	08/13/1998	0									14	
CUA0774	RV	10	08/13/1998	0	31.9	136	13.7	118	74900	3780	6120	2.3	10.4	2470
CUA0775	RV	10	08/13/1998	0	44.9	166	18.6	149	99000	4530	7810	3.6	14.9	3250
CUA0776	RV	10	08/13/1998	0	45.1	174	31.6	170	118000	4930	14300	3.6	15.8	5040
CUA0777	RV	10	08/13/1998	0	49.5	209	23	172	120000	4530	9360	2.8	16.6	4130
CUA0778	RV	10	08/13/1998	0	36.7	143	18.2	148	93500	4540	7540	3.1	12	3040
CUA0779	RV	10	08/13/1998	0	36.1	140	18.4	137	89200	4630	7420	3.1	13.3	2960
LC10300	RV	16	---	0	52	128	13	101	11	3550	9170		12	2300
LC10300	RV	16	---	0	60	132	13	105	11	2400	9420		10	1150
LC10300	RV	16	---	0.16	73	302	21	104	12	3950	10500		16	2200
LC10300	RV	16	---	0.33	81	384	17	117	14	4000	11400		17	1950
LC10300	RV	16	---	0.66	77	346	21	126	14	3950	12100		16	2400
LC10300	RV	16	---	0.89	48	105	20	104	8.2	3900	6590		13	2100
LC10300	RV	16	---	1.05	2	11	17	42	3	70	1290		1	1500
LC10300	RV	16	---	1.31	2	9	3	40	2.8	76	650			1300
LC10300	RV	16	---	1.9	2	11	1	47	2.8	56	560			1300
Surface Water - Total Metals (ug/l)														
LC50	RV	7	10/29/1996				3			9				593
LC50	RV	7	11/26/1996				4.1			9				668
LC50	RV	7	12/13/1996				5.3			15				538
LC50	RV	7	01/29/1997				2.2			8				427
LC50	RV	7	02/21/1997				2.7			21				338
LC50	RV	7	03/26/1997				1.7			27				243
LC50	RV	7	04/16/1997				1.2			20				219
LC50	RV	7	05/16/1997				1.7			355				313
LC50	RV	7	06/24/1997				1.3			22				260
LC50	RV	7	07/24/1997				2.1			13				441
LC50	RV	7	08/13/1997				2.5			9				624
LC50	RV	7	09/03/1997				3.1			14				652
LC50	RV	7	10/16/1997				3.1			8				554
LC50	RV	7	11/24/1997				2.1			11				354
LC50	RV	7	12/17/1997				3.7			46				430
LC50	RV	7	01/21/1998				2.6			10				410
LC50	RV	7	02/25/1998				1.8			7				274

Data Summary Table
Main Stem Coeur d`Alene - segment MidGradSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Total Metals (ug/l)														
LC50	RV	7	03/19/1998				1.2			**15**				**196**
LC50	RV	7	04/23/1998				1.1			**46**				**151**
LC50	RV	18	10/22/1998				**3**			6				**630**
LC50	RV	18	11/18/1998				**3**			9				**450**
LC50	RV	18	12/15/1998				2 UJ			8				**250**
LC50	RV	18	12/15/1998				2 UJ			9				**250**
LC50	RV	18	01/27/1999				2			4				**270**
LC50	RV	18	02/09/1999				**3**			5				**330**
LC50	RV	18	03/09/1999				2			5				**280**
LC50	RV	18	04/13/1999				1 UJ			6				**200**
LC50	RV	18	05/10/1999				1			10				**110**
LC50	RV	18	05/25/1999				2		**2200**	**230**	**210**			**210**
LC50	RV	18	06/08/1999				1			**16**				**130**
LC50	RV	18	07/13/1999				1.7			9.3				**249**
LC50	RV	18	08/11/1999				**2.4**			7.1				**356**
LC50	RV	18	09/01/1999				**2.8**			7				**457**
LC50	RV	18	09/22/1999				**2.9**			5.7				**542**
LC50	RV	18	10/20/1999				**2.9**			4.9				**498**
LC50	RV	7	05/28/1998				1.2			**37**				**162**
LC50	RV	7	06/24/1998				1.8			7				**309**
LC50	RV	7	07/27/1998				**2.8**			7				**518**
LC50	RV	7	08/25/1998				**2.8**			8				**549**
LC50	RV	7	09/23/1998				**3**			7				**619**
LC50	RV	7	10/26/1998				**3**			9				**612**
LC50	RV	7	11/24/1998				**3.3**			12				**375**
LC50	RV	7	01/04/1999				1.8			7				**218**
LC50	RV	7	01/14/1999				1.4			7				**239**
LC50	RV	7	02/23/1999				**2.7**			10				**353**
Surface Water - Dissolved Metals (ug/l)														
LC50	RV	7	10/29/1996				**2.9**			0.15				**592**
LC50	RV	7	11/26/1996				**4.1**			**3**				**677**
LC50	RV	7	12/13/1996				**5.6**			**5**				**550**
LC50	RV	7	01/29/1997				**2.1**			**4**				**408**
LC50	RV	7	02/21/1997				**2.6**			**6**				**335**
LC50	RV	7	03/26/1997				**1.7**			**5**				**241**
LC50	RV	7	04/16/1997				**1.1**			**3**				**192**

Data Summary Table
Main Stem Coeur d`Alene - segment MidGradSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Dissolved Metals (ug/l)														
LC50	RV	7	06/24/1997				1.3			6				267
LC50	RV	7	07/24/1997				2			4				448
LC50	RV	7	08/13/1997				2.5			4				634
LC50	RV	7	09/03/1997				3.1			3				660
LC50	RV	7	10/16/1997				4.8			1.5				549
LC50	RV	7	11/24/1997				1.9			3				348
LC50	RV	7	12/17/1997				3.3			4				402
LC50	RV	7	01/21/1998				2.6			1.5				396
LC50	RV	7	02/25/1998				1.7			1.5				280
LC50	RV	7	03/19/1998				1.1			3				174
LC50	RV	7	04/23/1998				0.7			3				126
LC50	RV	18	10/22/1998				3.5			2.5				654
LC50	RV	18	11/18/1998				3.1			1.1				459
LC50	RV	18	12/15/1998				1.5			1				249
LC50	RV	18	12/15/1998				1.8			1				237
LC50	RV	18	01/27/1999				1.7			1.1				277
LC50	RV	18	02/09/1999				2.8			1.1				333
LC50	RV	18	03/09/1999				2			1.3				292
LC50	RV	18	03/09/1999				1			1				65
LC50	RV	18	03/09/1999				1			1				20
LC50	RV	18	04/13/1999				1.2			1				191
LC50	RV	18	05/10/1999				1			1.2				111
LC50	RV	18	05/25/1999				1 U		14	3.2	20			67
LC50	RV	18	06/08/1999				1			1.8				128
LC50	RV	18	06/08/1999				1			1				111
LC50	RV	18	07/13/1999				2			3				252
LC50	RV	18	08/11/1999				2			3				367
LC50	RV	18	09/01/1999				3			3				478
LC50	RV	18	09/22/1999				3			2				528
LC50	RV	18	10/20/1999				3			1				535
LC50	RV	7	05/28/1998				1.2			6				145
LC50	RV	7	06/24/1998				1.8			3				275
LC50	RV	7	07/27/1998				2.8			3				510
LC50	RV	7	08/25/1998				2.8			3 U				535
LC50	RV	7	09/23/1998				3			3				606
LC50	RV	7	10/26/1998				2.9			3				590
LC50	RV	7	11/24/1998				3.3			3 U				370

Data Summary Table
Main Stem Coeur d`Alene - segment MidGradSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Dissolved Metals (ug/l)														
LC50	RV	7	01/04/1999				2.1			3 U				222
LC50	RV	7	01/14/1999				1.6			3 U				234
LC50	RV	7	02/23/1999				2.8			3				343
LC50	RV	7	12/09/1992				3.83			2.5				669.5
LC50	RV	7	01/20/1993				3.83			3				809
LC50	RV	7	02/23/1993				2.88			2.5				539.9
LC50	RV	7	03/09/1993				3.83			2.8				380.3
LC50	RV	7	03/23/1993				4.79			8.4				290.6
LC50	RV	7	04/05/1993				0.97			6.5				141.1
LC50	RV	7	04/21/1993				0.97			3.9				131.1
LC50	RV	7	05/03/1993				1.93			6.2				141.1
LC50	RV	7	05/18/1993				1.93			6.8				200.9
LC50	RV	7	06/01/1993				1.93			3.9				270.7
LC50	RV	7	06/22/1993				2.88			3.9				420.2
LC50	RV	7	07/20/1993				2.88			3.4				340.5
LC50	RV	7	08/24/1993				1.93			3.2				430.2
LC50	RV	7	09/22/1993				2.88			3.7				589.7
LC50	RV	7	10/21/1993				2.88			3				51.3
LC50	RV	7	11/19/1993				2.88			3.4				639.6
LC50	RV	7	12/14/1993				3.83			3.7				589.7
LC50	RV	7	01/19/1994				3.83			3				340.5
LC50	RV	7	02/15/1994				2.88			2.5				500
LC50	RV	7	03/06/1994				1.93			6.2				200.9
LC50	RV	7	03/16/1994				1.93			4.2				250.7
LC50	RV	7	04/05/1994				0.97			5.1				131.1
LC50	RV	7	04/13/1994				0.02			4.8				131.1
LC50	RV	7	04/19/1994				0.97			9.7				171
LC50	RV	7	05/11/1994				0.02			3.2				101.2
LC50	RV	7	06/15/1994				1.93			2.7				380.3
LC50	RV	7	07/21/1994				2.88			2.7				629.6
LC50	RV	7	08/17/1994				2.88			4.2				589.7
LC50	RV	7	09/21/1994				2.88			3.2				669.5
LC50	RV	7	10/06/1994				2.59			1.5				641.5
LC50	RV	7	11/22/1994				3.36			1.5				595.7
LC50	RV	7	12/16/1994				2.69			1.5				507.9
LC50	RV	7	01/12/1995				2.31			1.5				207.8
LC50	RV	7	02/16/1995				1.26			3				245.7

Data Summary Table
Main Stem Coeur d`Alene - segment MidGradSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Dissolved Metals (ug/l)														
LC50	RV	7	03/07/1995				1.26			1.5				253.7
LC50	RV	7	03/23/1995				1.93			4				199.9
LC50	RV	7	04/14/1995				1.73			4				189.9
LC50	RV	7	04/25/1995				1.54			5				175.9
LC50	RV	7	05/11/1995				2.59			5				165
LC50	RV	7	05/24/1995				1.83			4				230.8
LC50	RV	7	06/12/1995				1.64			6				264.7
LC50	RV	7	06/28/1995				1.64			4				321.5
LC50	RV	7	07/12/1995				2.02			6				401.3
LC50	RV	7	07/26/1995				2.21			3				494
LC50	RV	7	08/15/1995				2.4			1.5				552.8
LC50	RV	7	09/14/1995				2.5			3				631.6
LC50	RV	7	10/18/1995				2.4			8				364.4
LC50	RV	7	11/21/1995				1.54			3				226.8
LC50	RV	7	12/28/1995				2.31			4				367.4
LC50	RV	7	01/18/1996				1.35			3				169
LC50	RV	7	02/28/1996				1.83			8				458.1
LC50	RV	7	03/27/1996				1.35			3				255.7
LC50	RV	7	04/18/1996				0.88			3				192.9
LC50	RV	7	05/09/1996				1.54			3				286.6
LC50	RV	7	06/20/1996				1.83			5				386.3
LC50	RV	7	07/23/1996				2.5			3				698.4
LC50	RV	7	08/21/1996				2.97			1.5				797.1
LC50	RV	7	09/26/1996				2.5			4				630.6

ATTACHMENT 3
Statistical Summary Tables for Metals

Statistical Summary of Total Metals Concentrations in Surface Soil
Segment MidGradSeg04
Units: mg/kg

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	5	5	16.5	33.3	24.4	0.25	31.3	1	0	0
Arsenic	7	7	73	155	114	0.31	22	7	0	0
Cadmium	7	7	12.8	20	16	0.16	9.8	7	0	0
Copper	7	7	60.3	125	96.6	0.26	100	4	0	0
Iron	7	7	37,900	87,200	61,800	0.36	65,000	4	0	0
Lead	13	13	227	5,240	2,770	0.5	171	13	11	0
Manganese	7	7	2,860	6,690	4,800	0.35	3,597	4	0	0
Mercury	5	5	2.4	2.7	2.5	0.05	23.5	0	0	0
Silver	5	5	6.2	14.2	10.6	0.27	391	0	0	0
Zinc	7	7	1,180	2,950	2,140	0.31	280	7	1	0

Statistical Summary of Total Metals Concentrations in Subsurface Soil
Segment MidGradSeg04
Units: mg/kg

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Lead	12	12	91	17,000	4,430	1.48	171	8	4	0

Statistical Summary of Total Metals Concentrations in Sediment
Segment MidGradSeg04
Units: mg/kg

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	23	23	2	81	40.3	0.57	3.3	20	14	0
Arsenic	23	23	9	384	154	0.63	13.6	20	10	0
Cadmium	23	23	1	63.3	20.2	0.58	1.56	22	17	0
Copper	23	23	40	265	124	0.42	32.3	23	0	0
Iron	23	23	2.8	174,000	58,100	0.91	40,000	14	0	0
Lead	23	23	56	6,360	3,640	0.46	51.5	23	20	3
Manganese	23	23	560	14,800	7,630	0.5	1,210	21	2	0
Mercury	14	14	0.3	3.6	2.47	0.4	0.179	14	12	0
Silver	21	21	1	26.3	13.3	0.37	4.5	20	0	0
Zinc	23	23	1,150	6,260	2,880	0.44	200	23	18	0

Statistical Summary of Total Metals Concentrations in Surface Water
Segment MidGradSeg04
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Cadmium	45	42	1	5.3	2.38	0.38	2	25	0	0
Iron	1	1	2,200	2,200	2,200	< 0.001	300	1	0	0
Lead	45	45	4	355	24.8	2.45	15	10	2	0
Manganese	1	1	210	210	210	< 0.001	50	1	0	0
Zinc	45	45	110	668	374	0.43	30	45	27	0

Statistical Summary of Dissolved Metals Concentrations in Surface Water
Segment MidGradSeg04
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Cadmium	105	104	0.02	5.6	2.25	0.44	0.38	102	9	0
Iron	1	1	14	14	14	< 0.001	1,000	0	0	0
Lead	105	101	0.15	9.7	3.36	0.54	1.09	93	0	0
Manganese	1	1	20	20	20	< 0.001	20.4	0	0	0
Zinc	105	105	20	809	363	0.53	42	104	38	0

ATTACHMENT 4
Screening Levels

SCREENING LEVELS

Based on the results of the human health and ecological risk assessments, 10 chemicals of potential concern (COPCs) were identified for inclusion and evaluation in the RI. The COPCs and appropriate corresponding media (soil, sediment, groundwater, and surface water) are summarized in Table 1. For each of the COPCs listed in Table 1, a screening level was selected.

The screening levels were used in the RI to help identify source areas and media of concern that would be carried forward for evaluation in the feasibility study (FS). The following paragraphs discuss the rationale for the selection of the screening levels.

Applicable risk-based screening levels and background concentrations were compiled from available federal numeric criteria (e.g., National Ambient Water Quality Criteria), regional preliminary remediation goals (PRGs) (e.g., EPA Region IX PRGs), regional background studies for soil, sediment, and surface water, and other guidance documents (e.g., National Oceanographic and Atmospheric Administration freshwater sediment screening values). Selected RI screening levels are listed in Tables 2 through 4.

For the evaluation of site soil, sediment, groundwater, and surface water chemical data, the lowest available risk-based screening level for each media was selected as the screening level. If the lowest risk-based screening level was lower than the available background concentration, the background concentration was selected as the screening level.

Groundwater data are screened against surface water screening levels to evaluate the potential for impacts to surface water from groundwater discharge.

For site groundwater and surface water, total and dissolved metals data are evaluated separately. Risk-based screening levels for protection of human health (consumption of water) are based on total metals results, therefore, total metals data for site groundwater and surface water were evaluated against screening levels selected from human health risk-based screening levels. Risk-based screening levels for protection of aquatic life are based on dissolved metals results, therefore, dissolved metals data for site groundwater and surface water were evaluated against screening levels selected from aquatic life risk-based screening levels.

Table 1
Chemicals of Potential Concern

Chemical	Human Health COPC			Ecological COPC		
	Soil/Sediment	Groundwater	Surface Water	Soil	Sediment	Surface Water
Antimony	X	X				
Arsenic	X	X	X	X	X	
Cadmium	X	X	X	X	X	X
Copper				X	X	X
Iron	X					
Lead	X	X	X	X	X	X
Manganese	X		X			
Mercury			X		X	
Silver					X	
Zinc	X	X	X	X	X	X

Table 2
Selected Screening Levels for Groundwater and Surface Water—Coeur d'Alene River Basin and Coeur d'Alene Lake

Chemical	Surface Water Total (µg/L)	Surface Water Dissolved (µg/L)	Groundwater Total (µg/L)	Groundwater Dissolved (µg/L)
Antimony	6[a]	2.92[b]	6[a]	2.92[b]
Arsenic	50[a]	150[c,d]	50[a]	150[c,d]
Cadmium	2[e]	0.38[b]	2[e]	0.38[b]
Copper	1[e]	3.2[c,d]	1[e]	3.2[c,d]
Iron	300[a]	1,000[c,d]	300[a]	1,000[c,d]
Lead	15[a]	1.09[b]	15[a]	1.09[b]
Manganese	50[a]	20.4[b]	50[a]	20.4[b]
Mercury	2[a]	0.77[c,d]	2[a]	0.77[c,d]
Silver	100[a]	0.43[c,d]	100[a]	0.43[c,d]
Zinc	30[e]	42[c,d]	30[e]	42[c,d]

[a]40 CFR 141 and 143. National Primary and Secondary Drinking Water Regulations. U.S. EPA Office of Water. Office of Groundwater and Drinking Water. http://www.epa.gov/OGWDW/wot/appa.html. October 18, 1999.
[b]Dissolved surface water 95th percentile background concentrations calculated from URS project database.
[c]Freshwater NAWQC for protection of aquatic life are expressed in terms of the dissolved metal in the water column.
[d]Freshwater NAWQC for cadmium, copper, lead, silver, and zinc are expressed as a function of hardness (mg/L of CaCO3) in the water column.
Values above correspond to a hardness value of 30 mg/L.
[e]Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision. U.S. Department of
Energy. Office of Environmental Management. ES/ER/TM-96/R2. Value based on total metals concentration.

Note:
µg/L - microgram per liter

Table 3
Selected Screening Levels for Surface Water—Spokane River Basin

Chemical	SpokaneRSeg01		SpokaneRSeg02		SpokaneRSeg03	
	Surface Water Total (µg/L)	Surface Water Dissolved (µg/L)	Surface Water Total (µg/L)	Surface Water Dissolved (µg/L)	Surface Water Total (µg/L)	Surface Water Dissolved (µg/L)
Antimony	6[a]	2.92[b]	6[a]	2.92[b]	6[a]	2.92[b]
Arsenic	50[a]	150[c]	50[a]	150[c]	50[a]	150[c]
Cadmium	2[e]	0.38[b]	2[e]	0.38[b]	2[e]	0.38[b]
Copper	1[e]	2.3[c,d]	1[e]	3.8[c,d]	1[e]	5.7[c,d]
Iron	300[a]	1,000[c]	300[a]	1,000[c]	300[a]	1,000[c]
Lead	15[a]	1.09[b]	15[a]	1.09[b]	15[a]	1.4[c,d]
Manganese	50[a]	20.4[b]	50[a]	20.4[b]	50[a]	20.4[b]
Mercury	2[a]	0.77[c]	2[a]	0.77[c]	2[a]	0.77[c]
Silver	100[a]	0.22[c,d]	100[a]	0.62[c,d]	100[a]	1.4[c,d]
Zinc	30[e]	30[c,d]	30[e]	50[c,d]	30[e]	75[c,d]

[a]40 CFR 141 and 143. National Primary and Secondary Drinking Water Regulations. U.S. EPA Office of Water. Office of Groundwater and Drinking Water. http://www.epa.gov/OGWDW/wot/appa.html. October 18, 1999.
[b]Dissolved surface water 95th percentile background concentrations calculated from URS project database. Technical Memorandum. Estimation of Background Concentration in Soils, Sediments, and Surface Waters. Coeur d'Alene Basin RI/FS. URS. May 2001.
[c]Freshwater NAWQC for protection of aquatic life are expressed in terms of the dissolved metal in the water column.
[d]Freshwater NAWQC for cadmium, copper, lead, silver, and zinc are expressed as a function of hardness (mg/L of CaCO3) in the water column.
[e]Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision. U.S. Department of Energy. Office of Environmental Management. ES/ER/TM-96/R2. Value based on total metals concentration.

Note:
µg/L - microgram per liter

Table 4
Selected Screening Levels—Soil and Sediment

Chemical	Upper Coeur d'Alene River Basin		Lower Coeur d'Alene River Basin		Spokane River Basin	
	Soil (mg/kg)	Sediment (mg/kg)	Soil (mg/kg)	Sediment (mg/kg)	Soil (mg/kg)	Sediment (mg/kg)
Antimony	31.3[a]	3.30[b]	31.3[a]	3[c]	31.3[a]	3[c]
Arsenic	22[b]	13.6[b]	12.6[b]	12.6[b]	9.34[b]	9.34[b]
Cadmium	9.8[d]	1.56[b]	9.8[d]	0.678[b]	9.8[d]	0.72[b]
Copper	100[d]	32.3[b]	100[d]	28[c]	100[d]	28[c]
Iron	65,000[b]	40,000[c]	27,600[b]	40,000[c]	25,000[b]	40,000[c]
Lead	171[b]	51.5[b]	47.3[b]	47.3[b]	14.9[b]	14.9[b]
Manganese	3,597[b]	1,210[b]	1,760[a]	630[c]	1,760[a]	663[b]
Mercury	23.5[a]	0.179[b]	23.5[a]	0.179[b]	23.5[a]	0.174[c]
Silver	391[a]	4.5[c]	391[a]	4.5[c]	391[a]	4.5[c]
Zinc	280[b]	200[b]	97.1[b]	97.1[b]	66.4[b]	66.4[b]

[a]U.S. EPA Region IX Preliminary Remediation Goals for Residential or Industrial Soil. http://www.epa.gov/region09/wasate/sfund/prg. February 3, 2000.
[b]Technical Memorandum. Estimation of Background Concentration in Soils, Sediments, and Surface Waters. Coeur d'Alene Basin RI/FS. URS. May 2001.
[c]Values as presented in National Oceanographic and Atmospheric Administration Screening Quick Reference Tables, NOAA HAZMAT Report 99-1, Seattle, WA. M. F. Buchman, 1999. Values generated from numerous reference documents.
[d]Final Ecological Risk Assessment. Coeur d'Alene Basin RI/FS. Prepared by CH2M HILL/URS for EPA Region 10. May 18, 2001. Values are the lowest of the NOAEL-based PRGs for terrestrial biota (Table ES-3).

Note:
mg/kg - milligram per kilogram